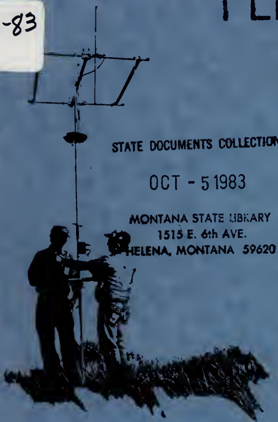
MONTANA DEPARTMENT OF FISH, WILDLIFE & PARKS

MONTANA DEER STUDIES



FEDERAL AID PROJECT W-120-R-14
PROGRESS REPORT FOR
THE PERIOD JULY 1, 1982 - JUNE 30, 1983

JOB PROGRESS REPORT

RESEARCH PROJECT SEGMENT

STATE	Montana		
PROJECT	W-120-R-14	NAME	Statewide Wildlife Research
STUDY NO.	BG-1.0	TITLE	Statewide Mule Deer Ecology Studies
JOB NOS.	1, 2, and 3	TITLES	(Various)
STUDY NO.	BG-2.0	TITLE	Statewide White-tailed Deer Ecology Studies
JOB NOS.	1, 3, and 5	TITLES	(Various)

Period Covered: July 1, 1982 - June 30, 1983

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INTRODUCTION

The statewide deer research program was initiated in July 1975. Background information on problems and needs was given in previous reports (Mackie et al. 1976, 1977, 1978, 1979, 1980, 1981, and 1982). Overall objectives were to:

1. provide a more detailed understanding of the population biology and habitat relationships of deer and of the factors influencing deer numbers in the diverse environments in which deer occur in Montana;

2. develop new or improved methods for measuring deer populations and habitat parameters, new guidelines for applying existing information and technology more effectively, and/or new criteria for interpreting field data in terms of management needs; and

3. establish new guidelines for consideration of the habitat requirements and relationships of deer in other game, range, forest, and land management programs and practices in Montana.

Present efforts continue most of the basic studies established during 1975-76, except those on deer in the prairie-agricultural habitats of eastern Montana. The prairie deer study was reestablished as a graduate (Ph.D.) thesis research project in July 1982. In addition, an intensive study of white-tailed deer on river bottom habitats along the lower Yellowstone river was established during the summer of 1980, and studies of white-tailed deer in northwestern Montana were extended to include another major coniferous forest habitat during 1981-82. Goals and objectives are generally similar to those outlined earlier, except that greater emphasis is now given to testing hypotheses developed from investigations and findings during the 1975-1980 period. Specifically, they are to:

1. further determine basis biological and ecological parameters for mule deer and white-tailed deer in populations associated with the major habitats in which the two species occur in Montana. These include population size/density, reproduction/recruitment, mortality/turnover, sex/age structure, longevity, and physical condition. They also include distribution, movements, use of specific habitat/cover types, food habits, and other behavioral patterns;

2. further relate those basic biological and ecological parameters to characteristics of individual habitats or environments, including topography, physiography, vegetation, weather and climate, and land use, as well as to specific potential limiting factors associated with individual habitats, study areas and populations. Those might include nutrition (forage production, availability, and quality), other wild ungulates, domestic livestock, livestock grazing and associated range management practices, logging and associated forest management practices, agriculture and associated cropping practices, and rurual subdivisions and associated human activities. They could also include hunting, predation, diseases and parasites, and weather;

3. further develop and test hypotheses relating to findings; particularly that: natural population regulation in deer is basically effected by interaction between inherent habitat characteristics and inherent requirements and behavioral attributes of the animals; that population phenomena and dynamics are the strategy by which deer populations exploit diverse habitats; and that population dynamics are indicators of basic habitat relationships of deer in the diverse habitats in which they occur; and

4. develop new methods, criteria, and guidelines for deer management including those for: assessing mule deer and white-tailed deer population characteristics in major habitats, assessing important habitat/environmental characteristics; relating population phenomena and dynamics of the two species to habitat/environmental characteristics, and vice-versa; relating population phenomena and dynamics to specific management opportunities or constraints; relating important habitat/environmental characteristics to specific management opportunities and constraints; measuring and/or interpreting the role and importance of various "limiting factors" in deer management programs; and for consideration of the requirements and habitat relationships of deer in other land use and management programs

This report compiles Job Progress Reports for individual jobs and investigations conducted on intensive study areas or in conjunction with the Statewide Deer Research Studies during 1982-83. The individual reports outline specific job objectives and procedures and present and discuss current findings in relation to information obtained previously. Findings and other information resulting from the studies have also been summarized in numerous separate publications. A listing of these is presented in an Appendix to this report.

STUDY NO. BG-1.0 JOB NO. 1

JOB TITLE: Population ecology and habitat relationships of mule deer in the mountain foothill habitats in southwestern Montana.

ABSTRACT:

Studies to evaluate factors affecting populations of mule deer in the Bridger Mountains were continued during 1982-1983. The winter of 1982-1983 was much milder than average with severe conditions generally restricted to the month of December. In late April, 92 deer with recognizable neckbands and radio-collars were present on the Armstrong study area, while about 89 marked animals were present on Brackett Creek. Approximately 62 marked deer occurred on the South 16-Mile winter range, 31 on Battle Ridge, 44 on Livingston, and 26 on Blacktail Mountain. Population data for the Armstrong winter range indicated that 233 deer were present in early winter; the number decreasing to 220 by spring. Over-winter mortality was light with the total reaching about 6 percent of early winter numbers. Only 10 percent of the fawns and 5 percent of adult females died. Observed ratios from winter aerial classifications were 58 fawns:100 females, 45 fawns:100 adults, and 28 males:100 females in early winter and 42 fawns:100 adults in late winter. The spring fawn: female ratio was 55:100, indicating high recruitment. During the 1982 hunting season, an estimated 195 (65%) of 300 either-sex permit holders hunted deer in HD312 and 81 killed deer. For HD393, an estimated 430 (86%) of 500 antlerless B-tag holders hunted deer and 251 killed deer. Calculations based on helicopter sampling efficiencies and the total number observed during late winter surveys indicated a population of 9,058 mule deer for the seven population units in the Bridger Range.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of mule deer populations associated with mountain-foothill habitats;

2. To relate those basic population parameters to (a) characteristics of individual habitats or environments and (b) specific, potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, domestic livestock grazing and range management practices, subdivisions and associated human activity, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management within mountain-foothill habitats.

INTRODUCTION

This report summarizes findings of studies on the population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana, for the period 1 July 1982 through 30 June 1983. These studies have included: (1) intensive studies of the distribution, movements, habitat use and population characteristics of mule deer associated with the Armstrong winter range, and (2) extensive studies of the seasonal distribution, habitat relations and population characteristics of mule deer throughout the Bridger Mountain Range complex. The history and general nature of both efforts were described by Mackie et al. (1978).

THE STUDY AREA

The Bridger Mountain Range (Figure 1) is located in northeastern Gallatin and northwestern Park counties, Montana. A detailed description of topographic, climatic and vegetative characteristics of this area, including the location of major mule deer winter ranges and associated seasonal ranges was presented by Mackie et al. (1978, 1980).

METHODS

Habitat Analysis

Habitat parameters measured and general methodology employed were described by Mackie et al. (1978).

Population Studies

Various methods employed in assessment of deer population characteristics have been described in previous reports (Mackie et al. 1978, 1979). During 1982-1983, early winter helicopter surveys (Mackie, Hamlin and Pac 1981) were conducted on the Northwest Slope winter range on 20 December 1982 and Brackett Creek on 26 December 1982. In late winter, all major winter ranges in the Bridger complex, excluding North 16-Mile, were surveyed on 15-21 March 1983. A separate estimate of mule deer numbers on the Armstrong winter range in spring was developed from ground observations on 9 days during April when a minimum of 95 deer were classified per survey.

Seven mule deer were captured with a helicopter and drive net (Beasom et al. 1980) on the Armstrong study area on 20 February 1983. Two were recaptures of previously tagged animals. One of these, an adult female, was fitted with a radio-collar, the remaining six deer were neckbanded. A summary of all mule deer tagged on the Armstrong study area from 1972 through 1983 and their status as of May 1983 is given in Table 1. At the end of May, functional radio-collars were worn by 3 adult females on the Armstrong study area and a yearling male that emigrated to the Southwest Slope population unit.

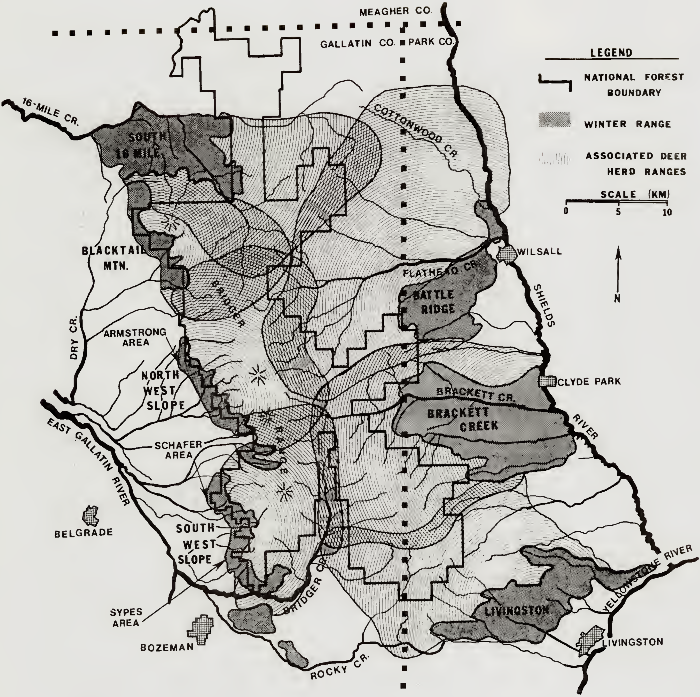

Figure 1. Map of the Bridger Range showing the location of seven mule deer year-long ranges and location of primary study areas.

Table 1. Summary of mule deer tagged on the Armstrong winter range from 1972 through 1983 and their status as of May 1, 1983.

Year	Total Number Marked	Number OK[1] May 1983	Number Dead[2]	Unknown[3]
1972	5	0	4 (3)	1
1973	16	0	11 (1)	5
1974	39	2	17 (3)	20
1975	36	4	24 (9)	8
1976	9	2	3 (1)	4
1977	16	3	8 (2)	5
1978	42	12	18 (6)	12
1979	72	17	29 (7)	26
1980	24	7	12 (3)	5
1981	11	6	3 (2)	2
1982	58	38	13 (2)	7
1983	5	6	0	0

[1] Number alive during spring 1983. Includes one adult female tagged as a fawn on South 16-Mile winter range in February 1982 and emigrated to AWR in 1982-83. Five males that wintered outside of study area boundaries are also included.

[2] Number shot by hunters in parentheses.

[3] Includes one female (#5-81) whose collar was found May 20, 1983, with rivets pulled out. This deer was known to be alive through 1983 spring observation period.

On 8 March 1983, 89 mule deer were trapped on the Brackett Creek winter range using a drive net and helicopter. All female deer were marked with "Ritchey" neckbands and males were marked with "Armortite" neckbands.

Effective during fall 1982, HD312 was divided into two separate hunting districts. The East Bridgers, HD393, generally encompassed the area occupied by the South 16-Mile, Battle Ridge, Brackett Creek and Livingston mule deer population units (Figure 1). The West Bridgers, HD312, included the Blacktail Mountain, Northwest Slope, and Southwest Slope mule deer population units (Figure 1), and the eastern portion of the Gallatin Valley. Information on hunter success, hunter distribution, and the total number, sex and age structure and distribution of the deer harvest during 1982 was determined from a mail questionnaire sent to all 300 either-sex permit holders in HD312 and 500 B-tag holders in HD393.

RESULTS AND DISCUSSION

Habitat Studies

Weather Conditions During Winter 1982-1983

The severity index for the Bozeman area during winter 1982-1983 was much milder than average (Table 2). Only two other winters since 1971-1972 have been milder.

Table 2. Climatological data, MSU Weather Station, Bozeman, and severity indices[1], 1971-1982, November through May.

	Avg. Temp. (°F)	Ppt. (In.)	Total Snowfall (In.)	Max. Snow Depth (In.)	No. Days Snow on Ground	Severity Index [1]
1971-72	33.9	7.7	81.8	10	119	-329
1972-73	31.3	8.4	92.6	14	135	+1335
1973-74	34.3	10.0	89.9	14	116	+2025
1974-75	30.5	12.1	118.6	17	161	+2286
1975-76	35.2	9.9	95.2	12	86	-810
1976-77	37.4	7.9	57.8	9	88	-2391
1977-78	33.9	10.0	60.5	12	111	+790
1978-79	29.9	10.7	87.4	18	159	+7843
1979-80	33.3	10.9	100.7	20	144	+752
1980-81	37.6	12.9	55.6	8	74	-2871
1981-82	32.8	11.5	125.3	11	129	+818
1982-83	35.4	8.4	87.4	12	97	-1569
21-yr. mean	32.54	9.45	87.7[2]	13.08[2]	118.25[2]	657[2]

[1]Follows Picton and Knight (1969). Positive values indicate greater severity.

[2]12-year mean.

The most severe period with respect to snow depth, snow coverage, and temperature occurred in December. Spring conditions (March-May) were less severe than the 12-year mean and less severe than spring 1982 (Table 3).

Table 3. Spring severity at MSU Weather Station, 1972-1983.

	March	April	May	March-April	April-May
1972	-586	-652	-958	-732	-805
1973	-303	-520	-989	-604	-754
1974	-206	-764	-880	-617	-822
1975	295	-141	-803	-216	-472
1976	262	-663	-1157	-519	-910
1977	-184	-875	-946	-668	-910
1978	59	-692	-886	-506	-789
1979	-125	-623	-1269	-672	-946
1980	526	-738	-1046	-419	-891
1981	-535	-734	-895	-721	-814
1982	-226	-452	-857	-512	-654
1983	-486	-549	-921	-652	-724
Mean 1972-83	-126	-617	-967	-570	-792

Mild conditions during February and March and early melting of the snowpack resulted in the earliest plant phenological development recorded on the Armstrong winter range in the past 5 years. Cooler, stormy weather in April slowed the rate of plant development although phenology of bluebunch wheat grass was still about two weeks earlier than had been recorded during the previous 4 years.

Distribution, Movements and Habitat Use

Winter

Aerial surveys during the mild winter of 1982-1983 indicated that mule deer population segments were widely distributed on their respective winter ranges throughtout much of the December through March period. Intermittent periods of deep snow in April and early May temporarily caused restricted distributions on some winter ranges. Deer associated with east-slope winter ranges began to disperse in mid-May; those on west slope ranges in early June.

Summer

Summer movement and distribution patterns of the Northwest Slope, Southwest Slope, Brackett Creek, and Battle Ridge population units were similar to other years. Summer distribution patterns were generally defined for the Blacktail, South 16-Mile, and Livingston population units during summer-fall 1982.

Population Characteristics

Trend and Dynamics of the Armstrong Deer Population

Trends in mule deer numbers and sex-age composition of the spring population on the Armstrong winter range from 1973-1982 were discussed in previous reports (Mackie et al. 1978, 1979, 1980, Pac et al. 1981, 1982). Population estimates for mule deer using the Armstrong winter range during spring 1983 are presented in Tables 4 and 5. Cumulative ground observations, aerial observations, and trapping records provided data on numbers of marked deer on the area throughout winter and early spring. In late April, approximately 92 deer wearing recognizable collars used the area between Tom Reese Creek and North Cottonwood Creek. Of those, 64 ranged between Bill Smith and North Cottonwood Creeks. The mean percentage of collared deer in April observations between Bill Smith and North Cottonwood Creeks was 30 percent.

The best estimate of mule deer numbers on the Armstrong winter range was 220 during spring 1983. The mean Lincoln Index for 9 ground surveys in April was 217 mule deer. The Schnabel Index was similar at 216 deer. The current population estimate is 23 percent higher than the estimate for spring 1982.

Estimates of mule deer numbers on the Armstrong range during early winter (Figure 2) were reconstructed from the spring population using overwinter mortality rates of marked adults, and fawn:female and male:female ratios observed during classification flights in late December. An early winter population estimate of 233 deer included about 126 adult females, 14 adult males, 20 yearling males, and 73 fawns.

The estimated 220 deer on the Armstrong winter range in spring 1983 included approximately 120 adult females, 14 adult males, 20 yearling males, and 66 fawns (Table 5). When compared with estimates for early winter, overwinter mortality was very light--approximately 6 percent of the early winter population. Mortality was apparently limited to fawns and old females. Four of 81 (5 percent) marked females wintering between Tom Reese and North Cottonwood were known to have died. Overwinter change in the fawn:adult ratio indicated a fawn mortality rate of 10 percent. Known deaths included 4 adult females, 1 unclassified adult, 3 fawns, and 2 carcasses of unknown sex and age in the area between Bill Smith and North Cottonwood Creeks. One unclassified adult and 2 fawns were known to have died in the area between Bill Smith and Tom Reese Creeks.

Hunting mortality of males appeared to be lower in 1982 than in the previous year. Tag returns in 1981 indicated a minimum of 5 (42 percent) of 12

Table 4. Spring estimates of numbers of mule deer on the Armstrong winter range, April, 1983.

Estimated Numbers		Remarks
Total	S	
217	11.9	$\overline{X}$ Lincoln Index for 9 ground surveys (95-180 deer obs./survey) and 61-68 collars in population.
216		Schnabel Index for 9 ground surveys (95-180 deer obs./survey) and 61-68 collars in population.

Table 5. Estimated late winter-spring mule deer populations on the Armstrong winter range, 1973-1983.

Year	Total No.	No. Adult Females	Number of Males		No. Fawns
			Adult	Yrlg.	
1973	230	123	31	27	49
1974	220	130	27	23	40
1975	140	92	35	8	5
1976	170	118	37	3	12
1977	200	120	24	6	50
1978	160	116	6	6	32
1979	140	104	6	11	19
1980	160	95	14	7	44
1981	170	98	13	6	53
1982	170	102	12	20	36
1983	220	120	14	20	66

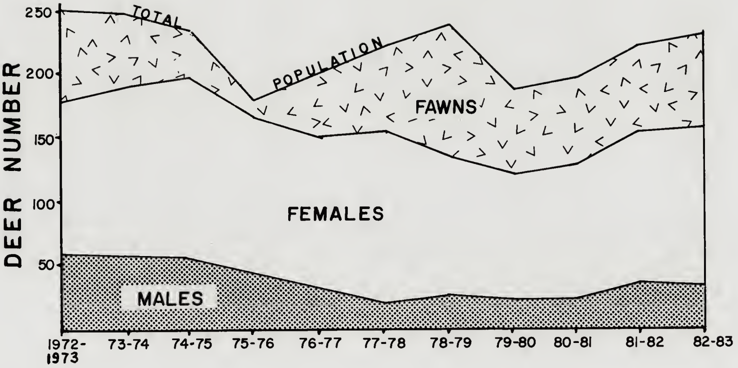

Figure 2. Early winter population trend of mule deer on the Armstrong winter range, Bridger Mountains, 1972-1983.

marked males were killed. During the 1982 hunting season, 3 (13%) of 24 marked males were shot. However, 2 (8%) of 24 marked males which left the winter range in May 1982 and presumed to be alive during fall were not observed during the winter. Seventy-nine percent of the marked males were known to be alive at the close of the hunting season. Two ear-tagged adult males that had lost their collars were shot during the 1982 hunting season. One had been marked as a fawn in February 1978 and was last observed in May of that year. The other was never observed after it was trapped as a fawn in January 1981.

Hunting was for males only, except for 300 either-sex permits issued for HD312 and 500 antlerless B-tags issued for HD393. After the 1982 hunting season, a special questionnaire was sent to all either-sex permit holders in HD312, and all B-tag holders in HD393. For HD312, 248 (83 percent) of the 300 questionnaires were returned. Harvest and hunting season projections made from the returned sample indicated that 195 (65 percent) of 300 permittees actually hunted deer in HD312. Hunters averaged 3.2 days afield. Of those that hunted, 42 percent were successful. Either-sex permit holders harvested an estimated 81 deer in 1982 consisting of 57 mule deer (30 females, 21 males, 6 fawns) and 24 white-tailed deer. For HD393, 411 (82 percent) of 500 questionnaires were returned. Projections made from the returned sample indicated that 430 (86 percent) of the 500 antlerless B-tag holders actually hunted deer in HD393. Hunters averaged 3.7 days afield. Of those that hunted, 58 percent were successful. Antlerless B-tag holders harvested an estimated 251 deer in 1982 consisting of 228 mule deer (200 females, 28 fawns) and 23 white-tailed deer.

Fawn Production and Survival

Aerial classifications of mule deer on the Armstrong range during helicopter surveys in late December 1982 and mid-March 1983 are listed and compared with data for previous years in Table 6.

The observed ratios (58 fawns:100 females and 45 fawns:100 adults in 1983) indicated above-average fawn survival to early winter. The mid-March ratio of 42 fawns:100 adults indicated that fawn survival to late winter was also above average. Ground classification in late-March and April indicated an overwinter fawn loss of 38 percent which was not consistent with documented mortality. Noticeable variation in fawn size was noted during April ground observation making identification difficult. This apparently resulted in an overly conservative estimate of their proportion in the spring population. Overwinter fawn mortality of 10 percent seemed more consistent with the low documented fawn mortality.

Late spring population estimates show 40 fawns:100 females in spring 1973, 31:100 in 1974, 5:100 in 1975, 10:100 in 1976, 42:100 in 1977, 27:100 in 1978, 18:100 in 1979, 46:100 in 1980, 54:100 in 1981, 35:100 in 1982, and 55:100 in 1983. Therefore, fawn survival to spring 1983 apparently was the highest recorded since the study began.

Table 6. Aerial classifications of mule deer on the Armstrong winter range, January 1972 through March 1983.

Reese Creek - N. Cottonwood	Total Count	Total Class.	NUMBERS Adults	Males	Females	Fawn	Uncl.	RATIOS F:100 Females	F:100A	Males:100 Females	PERCENTAGES % Fawn	% Yrlg. Males	% Spike Yrlg. Male
1971-72 Jan. 3	173	173	119	39	80	54	-	68	45	49	31	56	26
Mar. 28	92	83	68	-	-	15	9	-	22	-	18	-	-
1972-73 Feb. 7	188	188	143	-	-	55	-	-	31	-	24	-	-
1973-74 Dec. 27	131	131	100	28	72	31	-	43	31	39	24	46	62
Apr. 1	188	188	154	-	-	34	-	-	22	-	18	-	-
1974-75 Jan. 5	140	140	116	37	79	24	-	30	21	47	17	19	17
Mar. 23	227	227	214	-	-	13	-	-	6	-	6	-	-
Apr. 20	99	99	96	-	-	3	-	-	3	-	3	-	-
1975-76 Jan. 2	121	121	113	29	84	8	-	10	7	35	7	7	100
Mar. 15	102	102	90	-	-	12	-	-	13	-	12	-	-
1976-77 Jan. 5-9	90	90	70	14	56	20	-	36	29	25	22	21	100
Mar. 10-11	116	116	87	-	-	29	-	-	33	-	25	-	-
1977-78 Dec. 19	133	133	94	11	83	39	-	47	42	13	29	46	40
Apr. 2	126	126	101	-	-	25	-	-	25	-	20	-	-
1978-79 Dec. 26	118	118	68	14	54	50	-	93	74	26	42	43	29
Mar. 12	98	98	68	-	-	30	-	-	44	-	31	-	-
1979-80 Jan. 9	132	132	85	16	69	47	-	68	55	23	36	37	50
Mar. 17	101	73	28	-	-	28	-	-	38	-	28	-	-
1980-81 Jan. 8	69	68	44	7	36	25	1	69	57	19	36	29	50
Mar. 19	129	129	83	-	-	46	-	-	55	-	36	-	-
1981-82 Dec. 27	131	131	95	23	72	36	-	50	38	32	28	61	43
Mar. 23	162	161	110	-	-	51	1	-	46	-	32	-	-
Apr. 29	137	137	107	-	-	30	-	-	28	-	22	-	-
1982-83 Dec. 20	209	205	141	31	110	64	4	58	45	28	31	58	89
Mar. 15	169	169	119	-	-	50	-	-	42	-	30	-	-

General Population Characteristics of Bridger Mountain Mule Deer 1982-1983.

A total of 1,651 mule deer were classified on the Brackett Creek and Northwest Slope ranges in early winter helicopter surveys; 5,764 were classified on all 7 major ranges in late winter helicopter surveys (Table 7).

The total early winter count on the Northwest Slope was higher in 1982-1983 than any other year; that for Brackett Creek was the second highest recorded in 8 years. Sampling efficiency, estimated from marked animals, was about 61 percent for the Northwest Slope. In early winter, marked samples were not large enough on Brackett Creek to permit the computation of a sampling efficiency.

The total count for the entire Bridger Range in late winter 1982-1983 was the highest recorded since the study began. Late winter sampling efficiencies on east slope ranges were 68 percent on Livingston and Brackett Creek, 74 percent on South 16-Mile, 50 percent on Battle Ridge, and 83 percent on the Wilsall Bluff portion of Battle Ridge. The sampling efficiency on the west slope was 56 percent for both the Northwest Slope and Blacktail Mountain. This sampling efficiency of 56 percent was also applied to the Southwest Slope winter range which lacked sufficient numbers of marked deer. Using these data, a total mule deer population of 6,569 was estimated for east slope ranges and 2,489 for west slope ranges. The total population of 9,058 was substantially more than the 7,315 mule deer reported by Pac et al. (1982) for late winter 1982. The current mule deer population estimate for the Bridger Range reflects the cumulative effects of a generally increasing mule deer population during the last 4 years and comparatively light overwinter mortality during 1982-83.

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Table 7. Numbers and sex and age ratios of mule deer classified by aerial (helicopter) survey on various winter ranges in the 8ridger Mountain complex during early and late winter, 1971-72 through 1982-83.

		1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78		1978-79		1979-80		1980-81		1981-82		1982-83	
		Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
	No. Classif.	204	352	523		367	356*	412	600	288	266	236	281	325	315	302	252	285	325	69	362	414	489	451	457
NO. END	♂♂:100 ♀♀	39.6	-	-		39.8	-	31.1	-	29.9	-	24.7	-	19.7	-	16.7	-	18.8	-	19.4	-	39.6	-	28.6	-
WEST SLOPE	FF:100 ♀♀	62.3	-	-		38.3	-	34.8	-	9.2	-	37.0	-	48.7	-	84.7	-	66.2	-	69.4	-	[illegible]	-	61.5	-
	FF:100 AD	44.6	29.9	32.7		27.4	19.0	26.5	9.4	7.1	6.1	29.6	34.4	40.7	30.3	72.5	39.9	55.7	46.4	56.8	63.1	42.2	46.1	47.8	41.3
	No. Classif.	470	332	271		174	162	459	448	335	307	335	365	336	121	277	473	325	504	-	571	-	566	-	700
SO. ENO	♂♂:100 ♀♀	39.1	-	-		39.6	-	22.8	-	28.6	-	27.2	-	25.0	-	11.2	-	20.4	-	-	-	-	-	-	-
WEST SLOPE	FF:100 ♀♀	45.4	-	-		32.6	-	51.1	-	25.8	-	46.1	-	53.7	-	61.2	-	61.4	-	-	-	-	-	-	-
	FF:100 AD	32.6	26.7	38.1		23.4	14.8	41.6	31.7	20.0	12.0	36.2	30.8	42.9	31.2	55.0	39.9	50.9	43.5	-	54.7	-	47.6	-	41.1
	No. Classif.	-	-	-		-	-	79	-	174	-	69	133	221	93	172	92	-	191	-	194	-	240	-	237
BLACKTAIL	♂♂:100 ♀♀	-	-	-		-	-	48.6	-	33.3	-	24.3	-	19.2	-	11.9	-	-	-	-	-	-	-	-	-
MOUNTAIN	FF:100 ♀♀	-	-	-		-	-	64.8	-	27.7	-	62.1	-	50.7	-	90.4	-	-	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	43.6	-	20.8	-	50.0	37.1	42.5	40.9	80.8	27.8	-	59.1	-	59.0	-	42.9	-	41.9
	No. Classif.	-	-	-		-	-	378	-	290	-	307	-	543	-	601	728	-	725	-	881	-	988	-	1279
SOUTH	♂♂:100 ♀♀	-	-	-		-	-	6.2	-	16.2	-	5.0	-	7.5	-	14.0	-	-	-	-	-	-	-	-	-
16-MILE	FF:100 ♀♀	-	-	-		-	-	24.5	-	22.4	-	49.2	-	68.2	-	67.7	-	-	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	23.1	-	19.3	-	46.8	-	63.4	-	59.4	46.8	-	71.3	-	80.9	-	49.7	-	34.1
	No. Classif.	-	-	-		-	-	665	483+	766	725	814	831	910	1050	1267	1041	700	1204	-	-	-	-	-	-
NORTH	♂♂:100 ♀♀	-	-	-		-	-	6.6	-	15.9	-	8.0	-	9.5	-	14.9	-	16.8	-	-	-	-	-	-	-
16-MILE	FF:100 ♀♀	-	-	-		-	-	35.4	-	25.6	-	43.3	-	67.8	-	77.5	-	88.8	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	33.2	32.7	22.1	10.0	40.0	25.9	61.9	39.3	67.6	47.6	76.0	65.8	-	-	-	-	-	-
	No. Classif.	-	-	-		-	-	-	-	148	-	81	-	388	-	629	515	-	608	-	396	-	808	-	812
BATTLE	♂♂:100 ♀♀	-	-	-		-	-	-	-	5.3	-	24.5	-	22.8	-	24.6	-	-	-	-	-	-	-	-	-
RIDGE	FF:100 ♀♀	-	-	-		-	-	-	-	25.6	-	54.1	-	78.2	-	96.1	-	-	-	-	-	-	-	-	-
	FF:100 AO	-	-	-		-	-	-	-	24.3	-	47.2	-	63.7	-	77.1	42.7	-	65.7	-	94.1	-	61.0	-	45.0
	No. Classif.	-	-	-		-	-	299	-	560	-	-	-	978	509	1120	1057	579	1017	446	1212	1293	1707	1200	1612
8RACKETT	♂♂:100 ♀♀	-	-	-		-	-	11.3	-	5.0	-	-	-	12.2	-	13.1	-	7.5	-	11.3	-	12.7	-	15.1	-
CREEK	FF:100 ♀♀	-	-	-		-	-	49.4	-	32.5	-	-	-	74.1	-	77.2	-	81.7	-	91.3	-	79.4	-	62.0	-
	FF:100 AO	-	-	-		-	-	44.4	-	31.0	-	-	-	66.0	51.2	68.1	31.1	76.0	64.6	82.0	97.4	70.5	58.9	54.0	40.4
	No. Classif.	-	-	-		-	-	300	-	223	-	-	-	266	-	460	436	-	485	-	587	-	638	-	667
LIVINGSTON-	♂♂:100 ♀♀	-	-	-		-	-	12.8	-	10.7	-	-	-	18.9	-	24.1	-	-	-	-	-	-	-	-	-
8ILLMAN CR.	FF:100 ♀♀	-	-	-		-	-	41.0	-	26.1	-	-	-	67.1	-	74.4	-	-	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	36.3	-	23.6	-	-	-	56.4	-	57.6	28.2	-	63.9	-	95.7	-	36.3	-	41.6
	No. Classif.	-	-	-		-	-	-	-	-	-	-	-	28	-	26	-	-	22	-	-	-	-	-	-
OTHER	♂♂:100 ♀♀	-	-	-		-	-	-	-	-	-	-	-	7.1	-	11.1	-	-	-	-	-	-	-	-	-
MISCELLANEOUS	FF:100 ♀♀	-	-	-		-	-	-	-	-	-	-	-	92.9	-	100.0	-	-	-	-	-	-	-	-	-
AREAS	FF:100 AD	-	-	-		-	-	-	-	-	-	-	-	86.9	-	90.0	-	-	100.0	-	-	-	-	-	-
	No. Classif.	674	648	794		541	518	2592	1531	2784	1298	1842	1610	4060	2088	4854	4594	1889	3081	515	4203	1707	5436	1651	5764
BRIDGER	♂♂:100 ♀♀	39.3	-	-		39.7	-	14.8	-	16.5	-	13.5	-	14.6	-	16.0	-	19.1	-	12.5	-	18.8	-	18.6	-
RANGE	FF:100 ♀♀	50.3	-	-		36.4	-	38.7	-	25.1	-	45.0	-	66.4	-	77.7	-	78.1	-	88.3	-	74.8	-	62.0	-
TOTALS	FF:100 AO	36.1	28.3	34.4		26.1	18.5	33.7	22.3	21.5	9.7	39.6	29.3	58.0	39.9	66.9	43.9	67.9	62.1	78.2	81.3	62.9	51.4	52.3	40.0

*Not including 100+ unclassified
+Northwest of 16-Mile Creek only

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Submitted by: David F. Pac
Henry E. Jorgensen
Richard J. Mackie

STUDY NO. BG-1.0 JOB NO. 2

JOB TITLE: Population ecology and habitat relationships of mule deer in river breaks habitat in northcentral Montana.

ABSTRACT:

Mule deer fawn recruitment was good; however, the early winter population declined about 13% from the previous year due to winter mortality in 1981-82 and hunting mortality during 1982. White-tailed deer fawn recruitment was also good compared to previous lows. Twenty-nine percent of radio-collared mule deer fawns died during summer 1982. Four of these 5 deaths were attributed to coyote predation. Coyote predation on deer during winter 1982-83 was the lowest recorded during this study. Buck kill during the 1982 hunting season was lower than expected based on population level. This may have occurred because an abnormally lower number of male fawns than female fawns were recruited to yearling age in 1982. Crippling loss and/or illegal kill was estimated to be 10.8% of legal kill for antlerless deer during 1981 and 1982 and 1.7% for adult males during 1976-1982.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of mule deer populations associated with timbered breaks habitat of central and eastern Montana;

2. To relate those basic population parameters to (a) characteristics of specific individual habitats or environments and (b) specific, potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, domestic livestock grazing and range management practices, coyote predation, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population r ulation; and

4. To develop new methods, criteria, and guidelines for deer management, generally, and specifically, for timbered breaks habitats.

INTRODUCTION

In 1960, an intensive study of mule deer and their relationship to elk and domestic livestock was established on a representative 75,000 acre area in the Missouri River Breaks approximately 25 miles northeast of Roy, Montana. Habitat use and population studies were conducted from June 1960 through September 1963 and intermittently from October 1963 through May 1964 (Mackie 1970). From the summer of 1964 through spring 1975, less intensive studies were continued on the area primarily to obtain population data for mule deer (Mackie 1966, 1973, and 1976).

In July 1975, intensive studies resumed under the statewide deer research program to further evaluate factors regulating mule deer populations in the breaks type habitat of eastern Montana. Results through June 1982 were reported previously (Hamlin 1977, 1978, 1979, 1980, 1981, 1982 and Knowles 1976). In 1976, special studies were established to evaluate coyote-deer relationships. These included graduate thesis research projects investigating mortality of mule deer fawns during summer (Dood 1978, Riley 1982) and the distribution and abundance of small mammals (Trout 1978). They also included determination of coyote population characteristics and trends (Pyrah 1980, Schladweiler 1980). During the summer of 1976, a special study was also established to measure annual production of various grasses, forbs and browse species on various habitat types and to relate forage production to seasonal and annual weather conditions (Jorgensen 1982).

This report summarizes data collected during 1982-83 concerning deer population trends and characteristics and their relationship to environmental factors. Data on coyote population trends are summarized and discussed in Appendix A, while data on forage production and trends are presented and discussed in Appendix B.

STUDY AREA

The south study area encompasses all of the timbered "breaks" portion of the area described by Mackie (1970) as extending approximately 20 miles on a 4 to 7 mile wide belt adjacent to the Missouri River in Fergus County, Montana (Figure 1). It comprises approximately 100 square miles between U.S. Highway 191 on the west, the Skyline Trail on the east, the Missouri River on the north and the Musselshell trail on the south. Physiography, climate, land use and vegetation of this area were described in detail by Mackie (1970). Some of the work described in this report was conducted on the adjacent Missouri River Bottomlands described by Allen (1968) and NE across the river on the Nichols Coulee Resource Conservation Area (north study area) described by Knowles (1975).

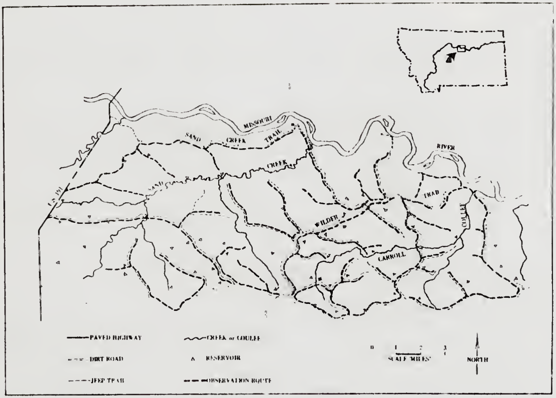

Figure 1. Map of the study area.

METHODS

Population data were obtained during fixed-wing surveys at various times of the year and helicopter surveys during December and March (Mackie, Hamlin and Pac 1980). Sex and age classifications and deer distribution and habitat use were obtained during all aerial surveys. Population estimates were made using data from helicopter surveys in most years. During the last 4 years, sufficient numbers of marked deer were present on the study area to permit use of the Lincoln Index (Overton and Davis 1969) for all aerial surveys. Supplementary information was obtained throughout the year from the ground during the course of normal activities.

Data on initial fawn production and subsequent fawn survival were obtained by aerial and ground reconnaissance. Survival was also measured by following radio-collared fawns. The river and reservoir ice was flown periodically during winter to check for coyote-killed deer. The uplands were checked for coyote-killed deer during aerial flights to relocate collared deer and during other normal activities. Carcasses are listed as probable coyote kills based on evidence of tracks in the snow, trails of blood on snow or vegetation and other site evidence. Deer have been captured during winter in order to attach radio transmitters or observational

collars. Methods have included the cannon net (Mackie et al. 1975), the Clover trap (Clover 1954), a helicopter drive net and darting from a helicopter. Newborn fawns are caught by the method described by Dood (1978).

Aerial relocations of radio-collared deer were obtained at 1-2 week intervals and relocations from the ground were made as time permitted.

Other techniques have been described in previous reports (Hamlin 1977, 1978, 1979, 1980).

RESULTS

Mule Deer Population Trend

Fawn recruitment improved somewhat from last year, remaining about twice as high as during the first 2 years of the study (Table 1 and Table 2). The population estimate for early winter 1981-82 was raised to 1,325 deer from the 1,200 figure reported earlier (Hamlin 1982). There was some indication that deer from adjacent prairie areas moved onto the study area during late fall and winter and that some yearlings, originally dispersing, returned to the study area in late fall and winter. The population estimate for early winter 1982-83 was 1,150 deer (Table 3, Figure 2). The population decline reflected overwinter mortality following the 1981-82 early winter estimate and hunting mortality during fall 1982. The population remains near peak historical levels.

White-tailed Deer Population Trend

White-tailed deer recruitment remained above the depressed level of 7-10 years ago (Table 4). Observing conditions at the time of the survey were poor, so the decline in total numbers observed probably was not indicative of a similar population decline.

Mule Deer Production and Mortality

Initial fawn production was excellent, but because of large numbers of yearlings, the percentage of females producing fawns was lower than average (Table 5).

Twenty-nine percent of the radio-collared fawns died during summer 1982 (Table 6). Four of the 5 deaths were the result of coyote predation and 1 was listed as unknown. The unknown death was suspected to have been the result of injury, infection, or disease. All other fawns appeared to be in good health prior to their death. Summer fawn mortality as determined by the change in age ratio method was 31 percent, essentially the same as determined with the radio-collared sample.

Table 1. Sex and age composition of mule deer population on the Missouri Breaks Study Area, 1960-61 through 1982-83. Data were derived as aerial or ground classifications during December or early January of each year except 1969-70 and 1972-73, when classifications were completed during February and March, respectively.

Year	Type of Observation	Number Classified	Percentage			Ratios			% of Yrlg. Males	
			Males	Females	Fawns	Males: 100 FF	Fawns: 100 FF	Fawns: 100 AD	Obsv.	Harv.
1960-61	Ground[1]	668	9.3	48.6	42.1	19.1	86.4	72.6	56	46
1961-62	Ground	430	15.5	60.7	24.0	25.3	39.5	31.5	74	47
1962-63	Ground	190	19.5	52.1	28.4	37.5	54.5	39.7	63	34
1963-64	Aerial[2]	362	16.0	45.6	38.4	35.1	84.2	63.3	47	36
1964-65	Aerial	611	22.7	47.8	29.5	47.6	61.6	41.7	47	43
1965-66	Aerial	434	21.4	58.1	20.5	36.9	35.3	25.8	33	13
1966-67	Aerial	289	17.3	52.6	30.1	32.9	57.2	43.1	46	
1967-68	Aerial[3]	115	20.0	40.0	40.0	50.0	100.0	66.7	--	
1968-69	None	-	-	-	-	-	-	-	--	
1969-70	Aerial	110	-	-	39.1	-	-	64.2	--	
1970-71	Aerial	776	18.8	48.1	33.1	39.1	68.9	49.5	47	
1971-72	Aerial	679	19.0	53.8	27.2	26.1	50.6	37.4	46	
1972-73	Aerial	235	-	-	19.1	-	-	23.7	--	
1973-74	Aerial	370	24.1	49.5	26.5	48.6	53.6	36.0	43	
1974-75	Aerial	315	25.6	55.1	19.3	46.0	35.1	24.0	50	
1975-76	Aerial	323	15.5	57.6	26.9	26.9	46.8	36.9	28	
1976-77	Aerial	258	17.4	57.4	25.2	30.4	43.9	33.6	40	
1977-78	Aerial	322	10.9	58.7	30.4	18.5	51.9	43.8	48	
1978-79	Aerial	501	13.2	42.3	44.5	31.1	105.2	80.2	55	
1979-80	Aerial	675	11.3	41.0	47.7	27.4	116.2	91.2	54	
1980-81	Aerial	850	12.5	45.8	41.8	27.2	91.3	71.7	64	
1981-82	Aerial	1055	11.9	49.3	38.8	24.2	78.7	63.3	64	
1982-83	Aerial	931	10.5	49.1	40.4	21.4	82.3	67.7	46	

[1]Cumulative observations on area during December.
[2]All aerial observations by helicopter except 1969-70 (fixed--wing aircraft).
[3]Only west half of study area surveyed in 1967-68.

Table 2. Classifications and observed recruitment of fawns on the south side Missouri Breaks study area, 1975-76 through 1982-83.

Date	Numbers	Adults	Young	Females	Males	Uncl.	Fawns/ 100 Adults	Fawns/ 100 FF
Sept.-Oct. 1975	105	69	36	50	19	-	52	72
December 1975	323	236	87	186	50	-	37	47
March 1976	193	173	19	--	--	-	11	--
October 1976	159	110	49	79	31	-	45	62
December 1976	258	193	65	148	45	-	34	44
March 1977	293	225	68	--	--	-	30	--
October 1977	112	70	41	51	20	-	59	80
December 1977	322	224	98	189	35	-	44	52
March 1978	255	195	51	--	--	9	26	--
September 1978	176	102	74	69	33	-	73	107
December 1978	501	278	223	212	66	-	80	105
March 1979	409	248	161	--	--	-	65	--
October 1979	278	157	120	100	57	1	76	120
January 1980	680	353	322	277	76	5	91	116
March 1980	683	375	308	--	--	-	82	--

Table 2. Continued.

Date	Numbers	Adults	Young	Females	Males	Uncl.	Fawns/ 100 Adults	Fawns/ 100 FF
September 1980	548	355	190	216	139	3	54	88
January 1981	854	495	355	389	106	4	72	91
March 1981	747	458	280	--	--	9	61	--
September 1981	671	447	230	292	151	-	51	79
December 1981	1062	646	409	520	126	7	63	79
March 1982	869	570	299	--	--	-	53	--
April 1982	295	205	90	--	--	-	44	--
October 1982	501	331	170	235	96	-	51	72
December 1982	934	555	376	457	98	3	68	82
March 1983	731	431	263	--	--	37	61	--
April 1983	493	307	181	--	--	5	59	--

Table 3. Population estimates of mule deer on the south Missouri River Breaks study area.[1]

	Males	Females	Fawns	TOTAL
1977-78 Early Winter	55	295	150	500
Late Winter	50	280	85	415
	43	42		
Predicted E. Winter 1978-79	93	322		
1978-79 Early Winter	95	310	325	735
Late Winter	90	295	250	635
	125	125		
Predicted E. Winter 1979-80	215	420		
1979-80 Early Winter	115	410	475	1000
Late Winter	105	395	410	910
	205	205		
Predicted E. Winter 1980-81	310	600		
1980-81 Early Winter	135	505	460	1100
Late Winter	130	480	370	980
	185	185		
Predicted E. Winter 1981-82	315	665		
1981-82 Early Winter	155	655	515	1325
Late Winter	145	615	335	1095
	168	167		
Predicted E. Winter 1982-83	313	782		
1982-83 Early Winter	120	565	465	1150
Late Winter	115	550	405	1070

[1] Early and late winter estimates are based on Lincoln Indexes, changes in sex and age ratios, and other indicators (Mackie et al. 1980). Predicted levels do not take hunting loss, dispersal or other mortality occurring between June and December into account.

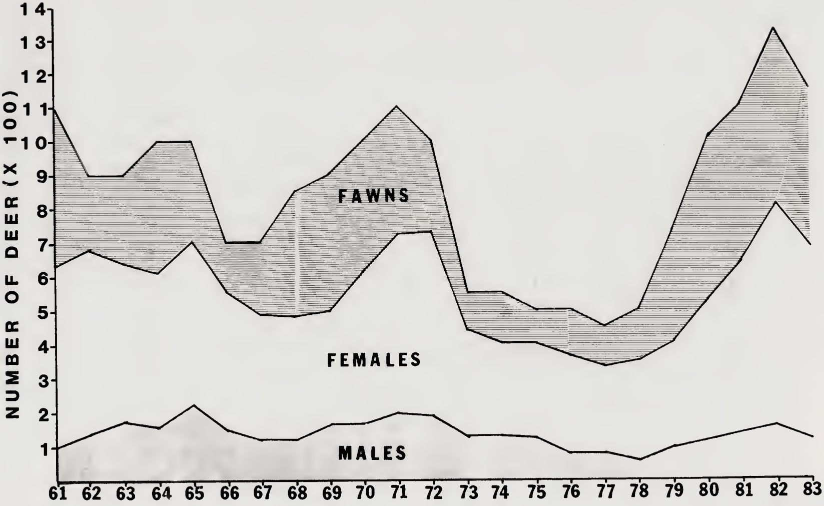

Figure 2. Mule deer population trend on the south study area, early winter 1961-1983.

Table 4. White-tailed deer numbers and sex and age composition from early winter surveys, 1960-1983.

Year	Numbers					Ratios			
	Total	Adult	Young	Female	Male	YG:100 AD	YG:100 Females	Male:100 Females	% Yearling Males
1960-61[1]	28	10	10	--	--	55.5	--	--	--
1961-62[1]	120	54	66	--	--	122.2	--	--	--
1962-63[1]	106	76	30	--	--	39.5	--	--	--
1964-65[2]	188	168	20	123	45	11.9	16.3	36.6	36.8
1965-66[2]	178	137	41	110	27	29.9	37.3	24.5	15.0
1966-67[2]	223	162	61	121	41	37.6	50.4	33.9	25.6
1971-72[2]	267	182	60	139	43	33.0	43.2	30.1	--
1973-74[2]	207	168	39	146	22	23.2	26.7	15.1	40.9
1975-76[2]	121	105	16	76	29	15.2	21.0	38.2	27.6
1976-77[2]	18	15	3	10	5	20.0	30.0	50.0	66.7
1977-78[2]	110	96	14	58	38	14.6	24.1	65.5	44.7
1978-79[2]	90	69	21	53	16	30.4	39.6	30.2	43.8
1979-80[3]	141	75	66	66	9	88.0	100.0	13.6	22.2
1980-81[4]	160	116	44	77	39	37.9	57.1	50.6	64.9
1981-82[4]	183	138	45	92	46	32.6	48.9	50.0	54.3
1982-83[4]	71	51	17	33	18	33.3	51.5	54.5	38.9

[1] Ground sample classifications.
[2] Helicopter surveys.
[3] Super Cub survey - 1-16-80, some males had probably lost their antlers, so both yg:100 female and male:100 female ratios would be somewhat higher than shown in the Table.
[4] Super Cub survey.

Table 5. Estimated mule deer fawn/female ratios in June and mid-July 1976-1982 on the south study area.

	Fawns/100 Producing Females		Percent Females Producing		Estimated Population Fawn/Doe Ratio
June 1976	150:100(14)[1]	x	94[2]	=	141:100
July 1976	131:100(16)	x	71[3]	=	94:100
June 1977	152:100(27)	x	82[3]	=	125:100
July 1977	140:100(20)	x	76[3]	=	106:100
June 1978	165:100(26)	x	90[3]	=	148:100
July 1978	142:100(31)	x	83[3]	=	118:100
June 1979	176:100(37)	x	70[2]	=	123:100
July 1979	168:100(37)	x	70[2]	=	118:100
June 1980	168:100(22)	x	75[2]	=	126:100
July 1980	157:100(63)	x	75[2]	=	118:100
June 1981	162:100(26)	x	78[2]	=	126:100
July 1981	141:100(59)	x	78[2]	=	110:100
June 1982	157:100(32)	x	67[2]	=	105:100
July 1982	143:100(80)	x	67[2]	=	96:100

[1]Female Sample size in parentheses.

[2]Percent of female population older than yearling.

[3]Percent of females observed alone or with fawns.

Table 6. Summer mortality and causes for marked mule deer fawns 1976-1982.

Year	No. Fawns Monitored	No. Died	% Mort.	No. Definite or Probable Coyote Killed	No. Unknown	No. Accident	% Coyote Killed
1976[1]	10	4	40	4	--	--	100
1977[1]	18	6	33	5	--	1	83
1978[2]	12	2	17	1	1	--	50
1979[2]	17	2	12	2	--	--	100
1980[2]	15	2	13	2	--	--	100
1981	19	4	21	4	--	--	100
1982	17	5	29	4	1	--	80
Total	108	25	23	22	2	1	88

[1]Data from Dood (1978) and personal communication.

[2]Data from S. Riley (personal communication).

Fall and winter mortality of fawns was low. One radio-collared fawn died as the result of coyote predation during winter. Probable coyote-killed deer found during winter are listed in Table 7. Winter 1982-83 was extremely mild and fewer coyote-killed deer were found than in previous years of the study.

Known hunting loss during 1982 was 39 adult males, 33 adult females and 11 fawns. The antlerless harvest was about the same as 1981, but the buck harvest was only about half that recorded in the previous two years. Preliminary data indicated that fewer bucks were available for harvest during 1982 than during the previous 2 years. During 1979, 1980 and 1981, the sex ratio of fawns recruited to 1 year old was about 100 males: 100 females. During 1982, the recruited yearling sex ratio was 46 males: 100 females. The drop in buck harvest may have been the result of a change in the sex ratio of recruited fawns-yearlings.

The either-sex hunting season for the last two years has given the opportunity for some data to be collected on crippling loss and/or illegal kill as a percentage of known legal kill. For the 1981 and 1982 hunting seasons combined, the crippling loss and/or illegal kill for antlerless deer amounted to 10.8 percent of the known legal kill. For the years 1976 through 1982, the comparable figure for adult males was 1.7 percent.

Table 7. Probable coyote-killed deer found during winter (December-March).

	Uplands	Bottomlands	River Ice	Reservoir Ice	Total
Mule Deer					
1975-76	9	2	1	33	45
1976-77	4	0	3	9	16
1977-78	5	0	2	1	8
1978-79	3	0	1	1	5
1979-80	0	0	2	5	7
1980-81	2	0	5	2	9
1981-82	10	1	1	1	13
1982-83	1	0	1	0	2
White-tailed Deer					
1975-76	1	10	9	0	20
1976-77	0	1	3	0	4
1977-78	0	1	0	0	1
1978-79	0	1	1	0	2
1979-80	0	0	1	0	1
1980-81	0	0	2	0	2
1981-82	0	0	1	0	1
1982-83	0	0	1	0	1

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Submitted by: Kenneth L. Hamlin

APPENDIX A

Coyote Population Characteristics and Trends in the Missouri River Breaks, 1976-1982.

by

Duane B. Pyrah

Kenneth L. Hamlin

INTRODUCTION

This report presents the results of the coyote surveys in 1982 which include siren surveys, den area estimates, average litter size, and radio locations (Pyrah 1980) in the south Missouri River Breaks (Mackie 1970). Litters were observed incidental to other surveys; however, aerial searches were made during those surveys to locate pups near litter dens of previous years.

RESULTS AND DISCUSSION

The coyote population in 1982 remained near the 4-yr level ($0.39/km^2$, $1/mi^2$) existing since 1979 (Table 1). Siren survey responses were nearly equal for the Wilder-Sand Creek and Musselshell-Skyline routes (Table 2), the latter being slightly higher in 1982 as in 1981.

Lower den area estimates during 1982 probably reflected the decreased field work. Fewer litters were observed during 1982 (Table 3). Seven litters averaged 2.3 pups, the lowest yearly average observed during 7 yrs. The average may be lower than actual due to the small sample. Still the 7-yr average litter size remains in excess of 3 pups; 55% of all observed litters contained 3 or 4 pups.

Breaks habitats continued to support significantly higher coyote densities than did prairie habitats (Table 4).

The 3 radio coyotes were located during deer location flights. The female (4-11) stopped moving between 10 February and 3 March 1983. She was reported dead (23 March) near the last location. One male (4-8 from lower Sand Creek) made several out-of-den-area movements before the radio ceased transmitting during spring of 1983. The other male (4-7 from Carroll Coulee) remains in that location and the transmitter still operates (1,503 days, 5 den seasons as of 30 June 1983).

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Table 1. Combined (siren, den area) survey for coyotes in the Missouri River breaks deer study area, 1977-82.

Den Area	1977			1978			1979			1980			1981			1982		
	SA[1/]	DAE[1/]	HC[1/]	SA	DAE	HC	SA	DAE	HC	SA	DAE	HC	SA	DAE	HC	SA	DAE	HC
A	4	6.2	6.2	1		1	4	5.2	5.2	4	3	3	0	3	3	3	4.3	4.3
B	3	6.2	6.2	1	5.8	5.8	4	5.2	5.2	5	4.8	5	1	4.9	4.9	5	4.3	5
C		5.2	5.2	5	5.8	5.8	4	6	6	3	4.8	4.8	0	2	2	3	4.3	4.3
D	1		1		5.8	5.8	6	5	6	5	4.8	5	3	4	4	6	3	6
E	8	5.2	8	5	5.8	5.8	5	7	7	7	4.8	7	6	5	6	6	4.3	6
F	2		2	1		1	6	6	6	4	4.8	4.8	6	9	9	5	3	5
G	6	9.2	9.2	6	7	7	6	5.2	6	5	5	5	7	4.9	7	7	6	7
H				4	6	6	5	6.2	6.2	4	3	4	6	5.9	6	4	6	6
I	1	7	7	8	5.8	8	6	5	6	7	4.8	7	5	7	7	7	4.3	7
J		6	6		5.8	5.8	7	8	8	3	3	3	4	4.9	4.9	1	3	3
K	2		2	8	5.8	8	2	5.2	5.2	3	6	6	4	4.9	4.9	4	4.3	4.3
L				2		2		6	6	4	4.8	4.8	3	4	4	5	4.3	5
M	6	5.2	6	1	8	8	4	5.2	5.2	6	4.8	6	1	3	3	5	4.3	5
N	1		1	1	6	6		3	3	2	0	2	3	4.9	4.9	2[2/]	4.3	4.3
O		5.2	5.2		5.8	5.8		6	6	3	4.8	4.8	5	4	5	0		0
P	1	5	5	1	6	6	3	5	5	2	8	8	6	5	6	3	5	5
Q		7	7	2	5	5		3	3	0	0	0	2	2	2	0		0
R		6	6	5	5	5		5.2	5.2	0	6	6	0	6	6	4	4	4
S	4	6.2	6.2		5	5	5	5.2	5.2	1	0	1	1	1	1	0		0
K1													6	6	6	3	4.3	4.3
Total	39	79.6	89.2	51	94.4	102.8	67	102.6	105.4	68	77.2	87.2	69	91.4	96.6	73	73	85.5

1/ SA = Siren Answers; DAE = Den Area Estimates; HC = High Count.
2/ 4 answered the siren at a listening station not on the route.

Table 2. Summary of siren survey coyote responses for high counts at each station, south study area, Missouri River breaks, 1976-82.

Study Area/ Route	Year	Number of Coyotes	Number of Stations	Average Coyotes Per Station	Density of Coyotes[1/]
Wilder-Sand Cr.	1976	56	11	5.09	0.28
	1977	51	12	4.25	0.23
	1978	35	12	2.92	0.16
	1979	56	12	4.67	0.25
	1980	62	13	4.77	0.26
	1981	52	13	4.00	0.22
	1982	59	13	4.54	0.25
	Avg.[2/]	53	12	4.32	0.24
Musselshell-Skyline	1976	50	10	5.00	0.27
	1977	33	10	3.30	0.18
	1978	40	11	3.64	0.20
	1979	28	11	2.55	0.14
	1980	46	11	4.18	0.23
	1981	59	11	5.36	0.29
	1982	53	11	4.82	0.26
	Avg.[2/]	44	11	4.12	0.23
Totals	1976	106	21	5.05	0.27
	1977	84	22	3.82	0.21
	1978	75	23	3.26	0.18
	1979	88	23	3.83	0.20
	1980	108	24	4.50	0.25
	1981	111	24	4.62	0.25
	1982	112	24	4.67	0.26
	Avg.[2/]	98	23	4.25	0.23

1/ Coyotes/km^2

2/ 7-yr arithmetic average; columns 4 and 5 are derived by division each year but not for the 7-yr average.

Table 3. Yearly frequency distribution of observed coyote litters in the Missouri River breaks, 1976-82.

Litter Size	1976	1977	1978	1979	1980	1981	1982	Total
1				2	2	2	3	9
2			2	1		4	1 1/	8
3	3	4	1	3	1	1	1	14
4	1	1	3	4	3	2	2	16
5	1		1			1		3
6			1	1		1		3
7	1							1
Total Litters	6	5	8	11	6	11	7	54
Total Young	25	16	30	35	17	32	16	171
Average Litter	4.2	3.2	3.8	3.2	2.8	2.9	2.3	3.2

1/ 1 pup observed dead nearby

Table 4. Comparison of coyote density and population trend between breaks and prairie habitats by siren responses assigned to den areas, Missouri River breaks, 1976-82.

	Breaks (263 km^2)		Prairie (172 km^2)	
Year	No.	Density ($/km^2$)1/	No.	Density ($/km^2$)1/
1976	57	0.22	35	0.20
1977	39	0.15	21	0.12
1978	51	0.19	23	0.13
1979	67	0.25	12	0.07
1980	68	0.26	32	0.19
1981	69	0.26	30	0.17
1982	73	0.28	30	0.17
Avg.	61	0.23*	26	0.15*

1/ Density of responding coyotes, not corrected for estimates of non-responders.

* Difference significant at $P < 0.05$ ($t = 3.253$, 5 df).

APPENDIX B

Forage Production and Trends in the Missouri River Breaks, 1976-1982

by

Henry E. Jorgensen

INTRODUCTION

This study of production of grasses, forbs and browse on selected habitat types within the Missouri River Breaks study area was established in 1976 to evaluate the response of various forage classes and species to weather conditions, the ultimate goal being to learn how to predict forage production from weather data. Through June 1980, the study was conducted within the framework of statewide habitat studies to evaluate existing range survey methods, concepts and criteria and develop practical methods of monitoring condition trends on big game ranges. During 1980, the study was included as part of investigations of population ecology and habitat relationships of mule deer in the Missouri River Breaks. In 1981, it was discovered from concurrent shrub ring width studies that widths of certain shrub annual growth rings were highly correlated with certain parameters of forage production. This report presents results of clipping studies during the summer of 1982 in relation to those of previous years.

Procedures for the clipping study followed those described by Jorgensen and Mackie (1978).

RESULTS

The production of grass, of all the categories of vegetation sampled in this study, was the most similar between macroplots (sample sites) and appeared to be most consistently related to variations in moisture conditions between years. Grass production in 1982 was higher than in most years except 1978 (Table 1). Production of forbs was significantly higher in 1982 than any other year. Weather conditions in 1982 were favorable for forb and grass production.

In 1982, production of Comandra was significantly less than all other years except 1981 on site 1 and less than 1978 and 1979 on site 2. Production varied more strongly and was consistently higher on site 2 than site 1, but production on neither site appeared related to weather conditions.

Dry matter production of sagebrush flower leaders was highest in 1981 and 1982.

Yellow sweetclover production in 1982 was low at both sampling sites compared to years of high production but varied most from the year of greatest production on site 1. On stand 2, 1982 production was similar to 1978 and significantly more than all other years.

Table 1. Current annual production on two sites in the sagebrush, bluebunch wheatgrass habitat type, Missouri Breaks, 1976-1982.

Species[1]	1976	1977	1978	1979	1980	1981	1982
Stand 1							
COUM	85[2]bc	101[3]c	87c	87c	56bc	30ab	14a
MEOF	15	≃0	72	464	0.62	2.6	41
FORBS	16a	10a	72b	8a	12a	72b	95c
GRASS	291bde	236ae	550c	288bde	178a	392bd	609c
ARTR[4]	8bc	30bc	ND[5]	3bc	30bc	96a	51c
Stand 2							
COUM	162abc	135ab	197c	182bc	139abc	104a	78a
MEOF	0.3	≃0	11	0.4	≃0	1.5	21
FORBS	15a	4a	116b	10a	14a	136b	220c
GRASS	461b	272a	1030d	437b	251a	526b	893d
ARTR[4]	11a	8a	ND	5a	13a	63b	59b

[1]Species abbreviations: COUM: *Comandra umbellata* (bastard toadflax)
MEOF: *Melilotus officinale* (yellow sweetclover)
ARTR: *Artemisia tridentata* (big sagebrush)

[2]Kilograms per hectare.

[3]Letters denote significant or nonsignificant differences between years. The same letter for any of the years means that the differences were not significant and vice versa.

[4]Flower leaders only.

[5]No data collected.

Shrub dry matter production in 1982 as determined from leader length measurements (Table 2) was mediocre on Stand 3 compared to preceding years. On Stand 5, 1982 production was higher than most preceding years for all species except skunkbush sumac.

Table 2. Current annual production of shrubs in the Douglas fir/chokecherry habitat type, 1976-1982.

	Stand 3[1]						
Species	1976	1977	1978	1979	1980	1981	1982
RONU[3]	38[4]	17	223	87	7	49	30
SYOC	28	8	36	52	25	19	16
PRVI	ND	13	24	88	17	19	15
RHTR	39	27	136	204	37	86	42
RISE	-	-	-	-	-	-	-
	Stand 5[2]						
Species	1976	1977	1978	1979	1980	1981	1982
RONU[3]	30	11	42	23	13	12	77
SYOC	11	10	20	13	10	30	17
PRVI	ND	32	46	65	25	35	70
RHTR	1	16	16	34	8	6	8
RISE	-	-	-	-	-	-	-

[1]East of Haines Ridge.

[2]West end of Sand Creek Trail.

[3]RONU: *Rosa nutkana* (rose), SYOC: *Symphoricarpos occidentalis* (snowberry), RISE: *Ribes setosum* (gooseberry), PRVI: *Prunus virginiana* (chokecherry), RHTR: *Rhus trilobata* (skunkbush sumac).

[4]Kilograms per hectare.

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STUDY NO. BG-1.0 JOB NO. 3

JOB TITLE: Population ecology and habitat relations of mule deer in prairie-agricultural habitat.

JOB OBJECTIVES:

1. Describe the demographics and habitat use patterns of mule deer in prairie-agricultural habitat.

2. Develop criteria and efficiency indices for estimating seasonal population sizes and population units.

3. Develop guidelines for determining allowable harvests for mule deer in this habitat.

INTRODUCTION

This study is an extension of studies by Hamlin (1976-1980), designed to gain more detailed information on the population dynamics and habitat use patterns of mule deer in prairie-agricultural habitat. Full time field work was limited to July-September 1982, and January-March 1983. Major efforts included marking deer and collecting preliminary population data. Additional full-time field work is scheduled to begin in June 1983 and run through September 1984. The major emphasis of the study will be directed toward mule deer. However, because mule deer share this range with white-tailed deer, pronghorn antelope, and range cattle, data will also be collected on these species.

ACKNOWLEDGMENTS

Sincere appreciation is extended to the numerous people from Montana State University, Montana Department of Fish, Wildlife and Parks, the Bureau of Land Management, the Livestock and Range Research Station in Miles City, and the numerous private landowners who provided immeasurable assistance in this study during the past year. The skills of pilots Jeff Tachenko and Keith Kinden, and helicopter pilot Larry Schweitzer greatly assisted data collection; their help is gratefully acknowledged.

STUDY AREA

The study area lies approximately 12 miles northwest of Terry, Montana (Figure 1). The general features and history of the area were described by Hamlin (1975). The study area boundary defined by Hamlin has been slightly modified to reflect a change in the emphasis of the study from white-tailed and mule deer to predominantly mule deer. A 58 square mile area on the north end of Hamlin's area was removed. That area is

Figure 1. Map of study area.

dominated by grain fields and used predominantly by white-tailed deer. Also, the long, narrow shape of the northern portion of Hamlin's study area increased the length of the perimeter relative to the area, and thus the chance of movement of marked deer across the study area boundary. The present study area is approximately 189 square miles and encompasses a mixture of interspersed prairie and agricultural habitats.

METHODS

Deer were trapped in January, using a drive-net and helicopter (Beasom et al. 1980). Each captured deer was marked with ear tags and individually recognizable neckbands or radio transmitters. All trapped deer were aged by tooth wear and replacement (Robinette et al. 1957). These data were used to generate the age structure of the population.

Aerial population surveys were conducted in September, December, and March from a piper supercub. A super cub was also used for biweekly relocation flights of radio collared deer from January through March. Additional relocations were obtained from the ground. Population estimates were developed by use of a Lincoln Index (Overton and Davis 1969) from counts of marked animals obtained during the March aerial survey.

Winter home range calculations were made for 45 mule deer and 15 white-tailed deer for the period from January through mid-April. Home range size was plotted as a function of the number of relocations to estimate the minimum number of relocations necessary for home range estimation. All home range calculations were done with 5 to 10 points and thus represent a minimum home range size.

RESULTS AND DISCUSSION

A total of 103 deer were trapped and marked, including 81 mule deer and 22 white-tailed deer. Of the 81 mule deer trapped, 32 females were fitted with radio transmitters, and the remaining 49 were fitted with neckbands; 23 were males and 58 were females. The age distribution of marked mule deer is illustrated in Figure 2. Of the 22 marked white-tailed deer, 10 adult females were fitted with radio transmitters and the other 12 were fitted with neckbands; four were male fawns and the remaining 18 were females (4 fawns).

Average winter home range size for mule deer was 1.42 square miles and ranged from a low of 0.19 (n=9) to 7.38 (n=6) square miles. However, calculations of the largest home range of 7.38 square miles included one location on April 15, which may have represented a movement toward a summer home range. The next largest home range was only 3.7 square miles (n=5).

During the March population survey, 700 mule deer were classified. Based on a Lincoln Index, the current population numbers between 980 and 1,134 mule deer. This represents a 600% increase in numbers in only 7 years (Figure 3). Both species of deer were quite visible in their winter

Figure 2. Sex and age structure of marked mule deer on the Terry study area, January 1983.

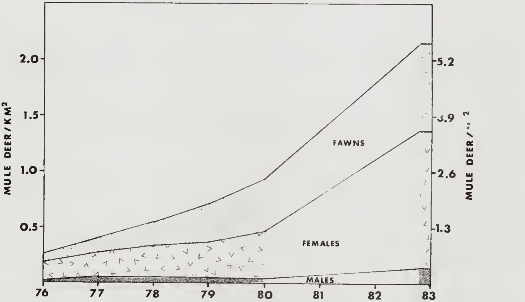

Figure 3. Late winter density estimates for mule deer on the Terry study area, 1976-83 (no data for 1981-82).

habitat. Approximately 67% of the marked mule deer were observed during the March survey. During a single relocation flight on February 21, 79% of all the marked animals were observed. From January through April, all but four marked animals were observed a least once.

Thirty-five percent of the March mule deer population was fawns. As of March 24, none of the radioed deer were known to have died. The fate of one radioed fawn is uncertain. A radio signal from this deer's transmitter was never received. One neckbanded female fawn was found dead on April 16. The carcass had not been fed on and examination of the bone marrow indicated malnutrition as the cause of death. The fawn had been feeding on green grass prior to its death, indicating that it had died only recently.

Winter home range size for white-tailed deer was much larger than that observed for mule deer. This is in agreement with the findings of Havel and Menzel (1969) as cited by Kramer (1972). Average home range size for white-tailed deer was 3.1 square miles and ranged from 1.96 (n=10) to 5.81 (n=6) square miles. The smallest white-tailed deer home range was larger than the average mule deer home range.

The maximum number of white-tailed deer counted on the study area was 148, counted during December. Insufficient numbers of white-tails were marked to allow a population estimate using a Lincoln Index. If white-tails were about as visible as mule deer, the population numbered between 200 and 240 individuals in March. However, 8 out of 10 of the radioed white-tails were off the study area during the March survey, indicating that much of the population was missed. Based on the ratio of mule deer to white-tailed deer present during the December survey, white-tail populations are probably closer to 330. Spring survey data indicated that recruitment of white-tailed deer fawns to the population in March was approximately 47% of the 1982 population level.

A maximum count of 320 pronghorn antelope was made during the September aerial survey. Only 123 and 157 pronghorns were counted in December and March, respectively. September classification estimates of fawn production were well below those conducted by Montana Department of Fish, Wildlife, and Parks (MDFWP) personnel. This is probably due to inaccurate classification of fawns in late September. Annual July surveys conducted by MDFWP personnel over a 280 square mile area including the study area classified 35% of the adult pronghorns as males (12% adult males and 23% yearling males) and 66% of the total population as fawns.

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Submitted by: Alan K. Wood

STUDY NO. BG-2.0 JOB NO. 1

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

ABSTRACT:

Studies to evaluate factors affecting populations of white-tailed deer (*Odocoileus virginianus*) in the Swan Valley and the Tally Lake area were continued during 1982-83. Data collected at the lower Swan Valley checking station included information on the harvest, hunting and harvest distribution, age structure, and weights and body measurements. Age classification indicated a fawn/adult ratio of 39/100 on the Tally Lake study area. A total of 57 deer was captured, marked for individual recognition, and released at Tally Lake. The sex and age composition of that sample differed from the previous trapping sample in the Swan Valley and from the 1982 sample for Tally Lake. Movements of radio-collared deer suggested that habitat use and migratory behavior may differ between the Swan Valley and Tally Lake populations.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of white-tailed deer populatins associated with coniferous forest habitats in northwestern Montana;

2. To relate those basic parameters to (a) characteristics of individual habitats or environments and (b) specific potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, logging and associated forest management practices, subdivisions and associated human activity, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management, generally, and specifically for coniferous forest habitats.

INTRODUCTION

The white-tailed deer (*Odocoileus virginianus*) is the most abundant and widely distributed big game species in northwestern Montana. Its distribution is closely associated with the mature coniferous forest. Recent trends have indicated reduced populations, concurrent with the development of large areas of deer habitat for other values.

Montana Statewide Deer Research included a study to evaluate factors affecting white-tailed deer in the Swan Valley. That area long has been an important deer range and is representative of a major ecological type in which white-tailed deer occur. The study has emphasized the collection of information basic to the distribution, movements, habitat use, and population dynamics.

The Northwest Montana White-tailed Deer Study was expanded during FY82 to include a study of white-tailed deer in the vicinity of Tally Lake. The emphasis of this study is similar to that in the Swan Valley.

STUDY AREA

The Swan River Valley occurs in southeastern Lake and northeastern Missoula counties. The valley lies between the Swan Range and the Mission Mountains and extends from the Swan-Clearwater Divide north, approximately 40 miles, to Swan Lake (Figure 1). The primary winter range lies between Goat Creek and Condon. Condon is approximately 70 miles northeast of Missoula and 65 miles southeast of Kalispell.

Hildebrand (1971) and Antos (1977) described the Swan Valley. The history of the deer population and summaries of early studies were presented by Weckwerth (1958), Hildebrand (1971), and Mundinger (1976).

Tally Lake is 10 miles west of Whitefish and 17 miles northwest of Kalispell. Tally Lake is a principle feature within an unnamed range of hills and low elevation mountains that extend from U.S. Highway 2, approximately 10 miles west of Kalispell, north and northwest to the Tobacco Valley, near Eureka. Within that range, the study area has been arbitrarily defined by the boundaries of Martin Creek on the north, and from the head of McMannamy Draw northwest to Ingalls Mountain and thence north to Fox and Grouse Mountains. Within the study area, Martin Creek, Good Creek, and Logan Creek, which flows through Tally Lake, are prominent tributaries of the Stillwater River. Sheppard Creek and Griffin Creek are prominent tributaries to Logan Creek. Star Meadows occurs at the confluence of the three creeks.

White-tailed deer winter along the eastern fringe of the range of hills, from Pilot Knob south the Ashley Creek. The study is concerned with this population of animals, and especially the segment that winters in the vicinity of the Ray Kuhns Wildlife Management Area (RKWMA) (Figure 2). That Wildlife Management Area was formed by the merger of lands

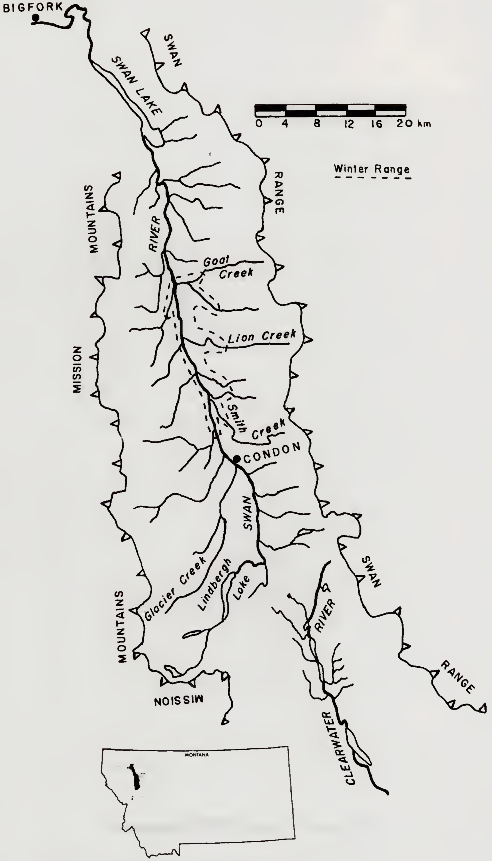

Figure 1. Map of the Swan River Valley Study Area.

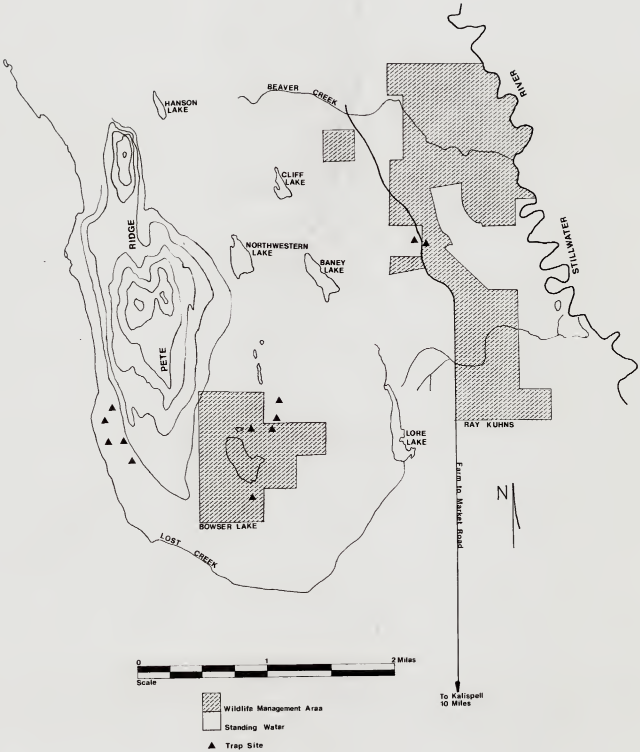

Figure 2. Map of the Bowser-Tally Lakes study area.

acquired by the Montana Department of Fish, Wildlife and Parks from the estate of Ray Kuhns with the former Bowser Lake Wildlife Management Area. RKWMA now includes 1,512 acres of deeded land and 79 acres of land which is leased from the Montana Department of State Lands.

Bowser Lake is 10 miles northwest of Kalispell. The RKWMA is accessed by the Farm to Market Road (Flathead County Road 424). Principle features of the area include the Stillwater River, Pete Ridge, the Lost Creek.

The RKWMA is occupied by mature, coniferous forest. The *Pseudotsuga menziesii/Symphoricarpos albus* H.T. (Pfister et al. 1977) is the major habitat type on the area. Douglas fir (*Pseudotsuga menziesii*) is the dominant species in a mixed overstory that also includes western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*), and a minor component of ponderosa pine (*Pinus ponderosa*). The *Picea/Clintonia uniflora* H.T., in which spruce (*Picea* spp.) is dominant, occurs along the Stillwater River and as minor inclusions near Bowser Lake. Major species in the forest understory include common juniper (*Juniperis communis*), snowberry (*Symphoricarpos albus*), pine grass (*Calamagrostis rubescens*), white spirea (*Spiraea betulifolia*), kinnikinnic (*Arctostaphylos uva-ursi*), and Oregon grape (*Berberis repens*). The understory also includes sparce amounts of serviceberry (*Amelanchier alnifolia*), mountain maple (*Acer glabrum*), and huckleberry (*Vaccinium* spp.). Arboreal lichens (*Allectoria* spp.) are common.

The climate in the vicinity of the RKWMA is milder than that which is typical of northwestern Montana. Average daily temperatures range between -7 and 19 C, and recorded extremes have been -37 and 38 C. The average annual precipitation is 42 cm, most of which occurs as snow. The average growing season is 105 days.

METHODS

Methods employed in the study were previously described (Mundinger 1980). During FY83, the primary field effort occurred on the Tally Lake Study Area, while a monitoring level was maintained in the Swan Valley.

A part-time checking station was operated in the Swan Valley during the 1982 hunting season. Hunters were interviewed to determine hunter origin, drainages hunted, and locations of animals observed and harvested. Ages of harvested animals were determined (Severinghaus 1949; Robinette et al. 1957; Quimby and Gaab 1957; Gilbert 1966). Weights and body measurements of white-tailed deer also were collected.

In the Swan Valley, 11 radio telemetry-equipped deer, collared during earlier years, were available for study. During the 1982-83 winter, 3 of these transmitters failed. These radio-equipped animals were periodically relocated primarily by fixed-wing aerial surveys. Two replications of the trend route in the Swan Valley study area were conducted.

Several clover traps (Clover 1954) were continually maintained on and adjacent to the RKWMA during early January through mid-March. A total of 19 fawn and yearling females were marked with metal ear tags and plastic neckbands, and 24 fawn and adult males were marked only with ear tags. Fourteen adult females were fitted with radio telemetry collars.

Radio-collared animals were periodically relocated, both from the ground by triangulation and from fixed-wing aerial surveys. After dispersal, the field effort primarily involved relocating these animals. Other deer observations, obtained incidental to that effort, also were recorded.

A vehicle route previously was established to census deer in the vicinity of the RKWMA during spring (Mundinger and Riley 1982). The route was driven during early evening and was completed after sunset. Two replications of the route were conducted during 1983. An attempt was made to census all deer that were visible from the route. When observed, deer were classified as to age, and if possible, to sex.

RESULTS AND DISCUSSION

The 1982 hunting season in the Swan Valley spanned 5 weeks. This included 8 days of either-sex and 4 weeks of males-only hunting. Hunting season statistics, as determined from the lower Swan Check Station and the Montana big game questionnaire, are presented for the 1975-82 hunting seasons in Table 1. These data indicate an average annual harvest of 679± s.e. 109 white-tailed deer over the 8-year period, and a preponderance of adult males in the harvest. Trends in hunter numbers and harvest were not consistent between questionnaire and check station data. Perhaps these differences were related to recent changes in the collection of questionnaire data. Four marked deer were harvested in the Swan Valley and reported during the 1982 hunting season.

The sex and age composition of the 1981 and 1982 deer harvest in the Swan Valley is presented in Table 2. These data generally are compatible with the age structure determined in prior years (Mundinger 1981). Survival rates, as estimated from the composite harvest age structure (Eberhardt 1969:474), were 0.661± 0.031 for yearling and older females and 0.613± 0.034 for 2½-year-old and older males.

Hog-dressed weights and body measurements (Table 3), as determined at the check station, indicated that white-tailed deer in the Swan Valley are larger than average white-tailed deer in Montana (Mackie 1964). These data also suggest that females continued to increase in size and weight through at least 3½ years, while males increased through 5½ years.

Table 1. Summary of 1975-1982 hunting seasons in the Swan Valley.

	1975	1976	1977	1978	1979	1980	1981	1982
Season Format								
Either Sex	10/19-11/9	10/24-10/31	10/23-10/30	10/22-10/29	10/21-10/28	10/19-10/26	10/25-11/1	10/24-10/31
Males Only	11/10-11/23	11/1-11/28	10/31-11/27	10/30-11/26	10/29-11/25	10/27 11/30	11/2-11/29	11/1-11/28
Hunter Days								
Questionnaire	40/511	33,606	39,691	31,653	30,914	28,244	23,550	27,304
Check Station	2,750	3,317	3,239	3,016	2,640	2,959	2,591	3,064
White-tailed Deer Harvest								
Questionnaire	635	523	736	625	612	746	668	883
Check Station	98	104	154	124	150	208	172	188
Mule Deer Harvest								
Questionnaire	70	94	86	69	96	128	112	176
Check Station	13	15	24	12	12	28	14	20
Elk Harvest								
Questionnaire	293	125	222	135	123	155	112	78
Check Station	51	29	39	29	29	35	37	40
White-tail, % adult males								
Questionnaire	55	74	79	79	67	71	72	80
Check Station	49	66	68	66	41	53	55	57
Deer Hunters								
Questionnaire	4,501	3,673	4,323	3,779	3,647	3,704	2,536	2,991
& Deer Hunter Success								
Questionnaire	17	17	20	18	20	24	31	35

Table 2. Percent composition, by age-class of the white-tailed deer harvest in the Swan Valley, 1981-82

Age	Female 1981	Female 1982	Male 1981	Male 1982	Total 1981	Total 1982
½	34	16	13	9	20	11
1½	36	30	51	57	46	47
2½	12	29	18	17	16	22
3½	2	7	2	6	2	6
4½	5	3	7	2	6	2
5½	2	4	3	5	2	5
6½	7	6	1	-	3	2
7½	-	1	2	2	1	2
8½	2	1	2	-	2	1
9½	-	-	1	2	1	1
10½	-	-	-	1	-	1
11½	-	-	1	-	1	-
12½	-	-	-	-	-	-
13½	-	1	-	-	-	1
Sample Size	58	69	104	116	162	185

Table 3. Average hog-dressed weight and body measurements of white-tailed deer harvested in the Swan Valley, Montana 1975-82

Sex	Age	Weight (lbs)	Length (cm)	Height (cm)	Hind Foot (cm)	Sample Size
Females	½	57.6	114.3	77.7	40.7	59
	1½	95.9*	134.3*	89.3*	45.6*	65
	2½	103.6*	140.1*	91.2*	46.2*	62
	3½	111.3*	143.2*	91.7	47.0*	22
	4½	114.6	144.3	92.6	46.8	18
	5½	109.4	140.4	94.3	45.8	8
	6½	113.0	143.8	92.7	46.4	12
	7½	109.3	135.3	92.3	46.3	2
	8½	118.2*	144.3	92.9	46.1	8
Males	½	63.0	116.1	80.5	42.0	57
	1½	112.0*	141.0*	93.7*	47.5*	216
	2½	143.2*	151.0*	99.4*	49.3*	92
	3½	159.7*	158.1*	102.4*	49.5	42
	4½	177.0*	159.6	103.0	49.8	28
	5½	186.4*	163.7*	104.1	50.3	21
	6½	186.2	165.2	105.4	49.7	12
	7½	183.1	164.2	105.4	49.8	13
	8½	189.1	165.7	102.7	50.6	5
	9½	194.7	165.8	104.0	49.8	3
	10½	179.5	160.3	102.6	48.5	4

*Significantly larger, $P < 0.05$, than preceding number in the column

Fawns of both sexes in the 1979 year-class were lighter and smaller than those in other year-classes (Table 4). Consistent with that observation, yearlings in 1980 (Table 5) and 2½-year-olds in 1981 (Table 6) were the lightest animals in each of those respective age-classes. Animals in the 1979 year-class were conceived after the "normal" 1977-78 winter and were born after the 1978-79 winter which was the most severe winter during the period of this study.

Fawns in the 1976 year-class, animals born after the mild 1975-76 winter, were heavy. Consistently, yearlings in 1977 and 2½-year-olds in 1978 also were heavy.

Table 4. Average hog-dressed weights and body measurements of white-tailed deer fawns, harvested in the Swan Valley, Montana.

	1975	1976	1977	1978	1979	1980	1981	1982
Females								
Weight (Lbs.)	58	63	60	53	55	60	63	58
Length (cm)			114.4	114.1	114.4	115.3	120.8	110.8
Height (cm)			78.7	76.8	76.4	78.3	80.8	77.5
Hind Foot (cm)			40.9	40.8	40.3	41.0	41.3	39.7
Males								
Weight (lbs)	63	63	67	64	59	65	63	63
Length (cm)		117.1	115.6	116.9	114.8	120.0	114.9	114.9
Height (cm)		76.4	83.0	79.6	78.9	82.1	81.0	81.1
Hind Foot (cm)		41.9	42.6	42.4	41.3	42.2	42.5	41.7

Table 5. Average hog-dressed weights and body measurements of yearling white-tailed deer harvested in the Swan Valley.

	1975	1976	1977	1978	1979	1980	1981	1982
Females								
Weight (lbs)		95	101	99	96	91	95	97
Length (cm)		133.8	132.2	132.2	138.0	130.8	139.5	133.6
Height (cm)		84.8	89.3	91.8	89.4	89.7	89.4	90.1
Hind Foot (cm)		45.1	46.2	45.4	45.7	45.4	45.6	45.6
Males								
Weight (lbs)	119	111	114	116	112	108	115	109
Length (cm)		139.6	141.6	140.7	142.4	139.9	141.4	140.9
Height (cm)		92.0	94.7	95.1	94.3	93.0	95.4	92.1
Hind Foot (cm)		47.6	48.1	47.7	47.5	47.4	48.0	46.8

Table 6. Average hog-dressed weights and body measurements of 2½-year-old white-tailed deer harvested in the Swan Valley, Montana

	1975	1976	1977	1978	1979	1980	1981	1982
Females								
Weight (lbs)	102	108	107	107	107	101	98	99.8
Length (cm)		140.0	138.5	140.5	143.0	141.3	141.5	138.2
Height (cm)		90.5	91.3	92.4	91.8	90.4	89.5	91.1
Hind Foot (cm)		46.3	46.5	47.9	46.5	45.8	45.3	45.8
Males								
Weight (lbs)	159	148	140	151	139	136	133	143
Length (cm)		155.3	147.1	151.6	148.3	148.8	151.3	153.6
Height (cm)		98.1	100.0	99.6	100.4	99.4	98.4	99.5
Hind Foot (cm)		49.9	49.4	49.9	48.6	49.2	48.5	49.2

A similar relationship perhaps should have been apparent for the 1977 year-class, because those animals were born after two successive mild winters. That relationship could not be demonstrated primarily because individual weights among animals in the 1977 year-class were more variable than those of the 1976 year-class. That variability was consistent among fawns, yearlings, and 2½-year-olds in the 1977 year-class during each of the corresponding years. Variability in weight among individuals may have occurred because recruitment during 1977-78 was above average and because an above average number of younger does (2½- and 3½-year-olds) reared young to recruitment age that year (Mundinger 1981).

A total of 59 white-tailed deer was observed in the Swan Valley. This included 35 adults, 22 fawns, and 2 animals unclassified as to age. This sample was too small to determine recruitment.

A total of 274 white-tailed deer was observed in the vicinity of the RKWMA during mid-winter surveys. The corresponding classification was 39 fawns:100 adults, or a recruitment rate of 27.1% (Table 7). That value was similar to the recruitment rate determined for 1982 (Mundinger and Riley 1982).

During 1982, a decline in the recruitment rate, suggestive of differentially greater fawn mortality, was recorded between the min-winter and spring surveys (Mundinger and Riley 1982). Such a difference was not indicated during 1983 (Table 7).

Table 7. Classification of white-tailed deer in the vicinity of the RKWMA winter range, 1983.

Date	Total	Adults	Fawns	Unclr	Fawns/ 100 Adults	% Fawns	
Mid-Winter	274	191	75	8	39	28.2	±3.5[a]
- 17 Mar 83	46	34	12		35	26.1	
- 24 Mar 83	30	21	9		43	30.0	
Spring Total	77	56	21		38	27.3	±6.5
1983 Total	351	247	96	8	39	28.0	±3.1
1982 Total	916	674	225	17	33	25.0	±1.9

a 0.90 confidence interval

A total of 65 white-tailed deer was captured in the vicinity of the RKWMA. The majority of the captured animals were fawns and adult females (Table 8). Comparisons between the 1982 (Mundinger and Riley 1982) and 1983 samples indicated that fewer older adult females and more fawns were captured during 1983. Also, the sex ratio of fawns differed between the two samples. During 1982, 19 of 25 fawns (76%) were females, whereas 20 of 35 fawns (57%) captured in 1983 were males.

Table 8. Number of white-tailed deer, by sex- and age-class, captured in the vicinity of the RKWMA winter range, 1983.

	Age-class				
Sex	½	1½	2½	3½	4+
Males	20	5	3		
Females	15	6		6	10

35 fawns/22 females = 159 fawns/100 females

Analysis of habitat use in the Tally Lake area is preliminary and only general statements are possible at this time. Concentrated deer use on the RKWMA occurred on Lost Creek bottom and in the vicinity of the small potholes north of Bowser Lake. Concentrated deer use also may have occurred in riparian habitat adjacent to the Stillwater River, but the sample of radio-collared deer did not include individuals that wintered in that area. Concentrated deer use in riparian habitats was less pronounced than that which occured in the Swan Valley (Mundinger 1980), probably because riparian habitats are limited on the RKWMA. By comparison with deer in the Swan Valley, deer on the RKWMA were more mobile, less dependent on specific activity centers, and may have used larger winter home ranges. Similar to the Swan Valley, winter deer use on the RKWMA occurred, almost exclusively in the coniferous forest.

The majority of animals in the sample of radio-collared does returned to the RKWMA during late December-early January (Table 9). Thereafter, concentrated deer use was apparent on the winter range.

Table 9. Dates of return to the RKWMA winter range by 16 radio-equipped white-tailed deer females, 1982-83.

Time Period	Prior To 11/17	11/18-11/27	11/28-12/7	12/8-12/17	12/18-12/27	12/28-1/6	1/7-1/16
Number of Deer	1	1	0	3	5	5	1

Dispersal from the RKWMA winter range generally spanned the same time period during 1982 and 1983 (Table 10). However, the majority of animals dispersed during a brief period in April, 1982, whereas the majority of animals left during a brief period in March, 1983. Coincident with this difference, deer use of the agricultural fields, adjacent to RKWMA, was less apparent and few deer were observed during the spring surveys (Table 7).

Three migration routes were apparent from dispersal movements recorded during 1982 (Mundinger and Riley 1982). Dispersal during 1983 followed the same route. Also, individuals followed during both springs followed the same routes and delayed at the same intermediate locations each year. During 1982 and 1983 the last animals to disperse from RKWMA followed the route over Reid Divide into Star Meadows.

Table 10. Dates of depature from the RKWMA winter range by radio-equipped white-tailed deer females, 1982-83.

Time Period	3/7-3/13	3/14-3/20	3/21-3/27	3/28-4/3	4/4-4/10	4/11-4/17	4/18-4/24	4/25-5/1	5/2-5/8
Number of Deer									
1982	1	0	0	1	4	5	6	1	0
1983	7	12	3	0	3	0	2	1	1

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Shawn J. Riley

STUDY NO. BG-2.0 JOB NO. 3

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in river bottom habitat in eastern Montana.

ABSTRACT:

Studies to evaluate factors affecting populations of white-tailed deer (*Odocoileus virginianus*) on islands and floodplain of the lower Yellowstone River were continued in 1982-83. Intensive research was continued in 3 units between Glendive and Sidney, Montana, while general monitoring was continued on the entire river bottom. Fall aerial classification indicated a fawn:adult female ratio of 95:100 (143:100 producing females), which compared to a ratio of 92:100 for individually marked females based on differential productivity by age class. Forty percent of the adult females (1½+), which included 12 percent of those older than yearlings, did not produce or successfully rear fawns to fall 1982. Rates of survival and mortality within the population by sex and age class were evaluated. Twenty-two percent of the population during fall 1982 was removed by hunting. Numbers of deer in the study area, which exceeded 5,000 during fall 1982, had increased by approximately 27 percent from fall 1981. Reduced fawn production and/or rearing success among adult females from previous years has attributed to disrupted maternal behavior of the youngest females of producing age (2½) as a result of social competition during early to mid summer. Evaluation of habitat relationships was also continued. During fall and winter 1982-83, the study was expanded to evaluate relationships between white-tailed deer populations on the river bottom and adjacent upland, prairie-agricultural habitat. Forty-nine deer were marked on a 35 mi^2 area approximately 30 miles northwest of the Yellowstone River. Aerial surveys of that area indicated a late winter population of approximately 444 deer (13/mi^2). Fawns accounted for 42, 48, and 43 percent of fall, early winter, and late winter-early spring populations. respectively.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of white-tailed deer populations associated with river bottom/riparian habitat in eastern Montana;

2. To relate these basic population parameters to (a) characteristics of individual habitats or environments and (b) specific potential limiting factors associated with individual populations and habitats, including nutrition, agriculture and associated farming practices, domestic livestock and associated grazing/range management practices, weather disease and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria and guidelines for deer management, generally, and specifically for river bottom habitats.

INTRODUCTION

This report summarizes findings from 1982-83 studies of population ecology and habitat relationships of white-tailed deer along the flood plain and islands of the lower Yellowstone River (Dusek 1981, 1982). These studies continued intensive research, initiated in July 1980, on 3 segments of river bottom between Glendive and Sidney, Montana (Figure 1). Results of two supplemental graduate thesis research studies to (1) determine and define successional relationships of riparian communities and (2) to determine circadian movements and habitat use by white-tailed deer on two units of lower Yellowstone River bottomlands are reported separately as supplements to this report.

Because previous studies (Dusek 1981, 1982) have indicated that some deer marked on the river bottom seasonally used or dispersed to adjacent uplands, the study was expanded during fall and winter 1982-83 to include general investigations of a white-tailed population associated with prairie-agricultural habitat along the Yellowstone-Missouri River Divide, northwest of the primary study area. These investigations, designed to generally evaluate relationships between river bottom and upland populations, are conducted in cooperation with Regional Deer Management Surveys and Investigations. Although limited to fall, early winter, and late winter-early spring population surveys and periodic monitoring of 15 radio-collared and 34 neckbanded deer, the studies should also provide information on how white-tailed deer populations use prairie-agricultural habitats and respond to/are influenced by intensive farming practices in a habitat where stands of deciduous trees and shrubs used for escape and thermal cover are of limited abundance and size. They may also provide baseline data for assessment of impacts of the development of underlying coal and gas reserves on white-tailed deer.

STUDY AREAS

The principal study area (Figure 1) includes approximately 53 miles of river floodplain and islands crossing portions of Dawson, Wibaux and Richland Counties. Land use practices and physiographical and vegetal characteristics of the area were described previously (Dusek 1981, Boggs 1981). Weather conditions during the period of November 15, 1982 through March 31, 1983 and the cumulative weather severity index (Picton and Knight 1969) indicated a comparatively mild winter (Table 1).

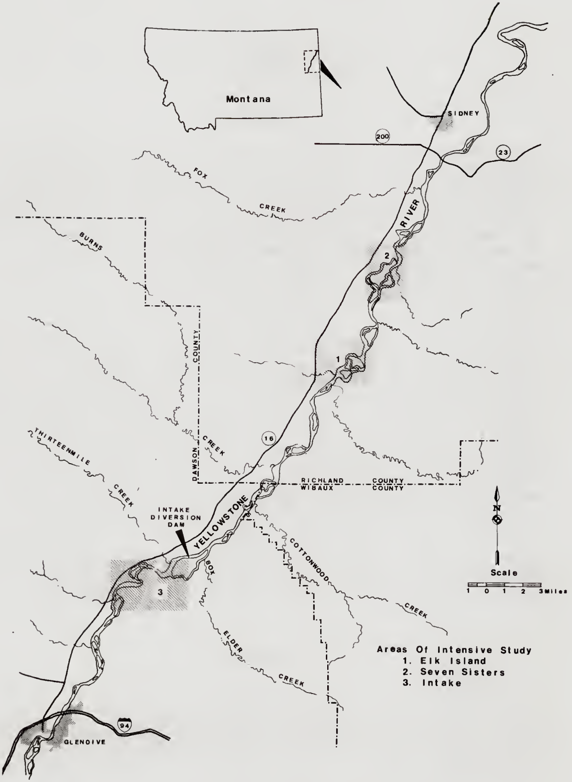

Figure 1. The lower Yellowstone River study area.

Table 1. Climatological data and weather severity indices for the period of mid-November through March from weather records for Sidney, Montana.

Year	No. days w/[a] temp. below freezing (F)	No. days w/[b] snow on ground	Total precip. (in.)	Maximum snow depth (in.)	Severity[c] index
1977-78	93	122	2.40	15	+17,835
1978-79	99	137	2.69	25	+24,028
1979-80	62	69	1.30	10	+1,565
1980-81	40	25	0.99	7	-600
1981-82	72	113	3.92	19	+13,242
1982-83	44	80	2.19	7	+457
Average	68	91	2.25	14	+9,421

[a]Number of days in which maximum daily temperature did not exceed 32°F.

[b]Number of days in which there was 1 or more inches of snow cover.

[c]Weather severity index is from Picton and Knight (1969).

The upland (Richey-Bloomfield) study area, established during fall and winter, 1982-83, includes approximately 35 mi^2 located about 30 air miles northwest of Savage and the Yellowstone River. Bordered by Highway 200 on the north and uplands along the Yellowstone-Missouri Divide on the south, the area is characterized by native mixed-grain prairie interspersed by croplands, hay meadows, and hardwood draws. Major drainages include Pasture and Lisk Creeks, both in the Missouri River Basin. The area is part of Montana Deer Hunting District 732.

METHODS

Procedures on the river-bottom study followed those of Dusek (1981, 1982). An additional 64 deer were captured and marked during January-March 1983. These included recaptures of 6 animals initially marked during one of the previous three winters. Fifteen were equipped with radio collars.

On the Richey-Bloomfield area, fixed-wing aerial surveys were conducted during October and December 1982 and March 1983 to determine population characteristics, including composition and fawn production/recruitment for the year ending May 31, 1983. During January 1983, 49 white-tailed deer were captured using a helicopter and drive net; 15 adult females were fitted with radio collars, the remainder with individually recognizable neckbands. Radio-collared deer were relocated 1-2 times monthly from fixed-wing aircraft during February-May 1983. Neckbanded animals were relocated as observed during radio-relocation flights and the March aerial survey. A population estimate for the area was derived as a Lincoln Index based on the ratio of marked to unmarked deer observed during the March survey. During fall 1982, the ages of 70 hunter-killed white-tails from HD732 were estimated by tooth eruption and wear and cementum analysis (Severinghaus 1949, Gilbert 1968).

RESULTS

Population Characteristics and Habitat Use (YRB)

Herd Composition

Composition of the white-tail population by sex and age, as determined from aerial classification during fall, early winter, and early spring is shown in Table 2. Sex-age structure of fall (pre-hunt) populations during 1982 as compared with previous years is shown in Figure 2. For the latter, proportions of females older than fawns and males older than yearlings were determined from the relative proportions of cohorts within these groups in samples of harvested deer examined at check stations and in field checks of hunters. Ages of deer harvested in 1981 and 1982 were back-dated to increase sample sizes for 1980 and 1981.

During 1982, deer aged 4½ years and younger comprised 88% of the pre-hunt population (Figure 2). In previous years, those age classes have comprised approximately 90% of pre-hunt populations on the Yellowstone River (Dusek 1981, 1982).

The proportion of fawns in the pre-hunt population has steadily declined since 1980 (Figure 2, Table 2), though recruitment was high ($\bar{X}$ = 42.7%) during all 3 years (Table 2). The sex ratio of fawns during 1982 may have been slightly heavy toward males--18 (58%) of a combined sample of 31 hunter- and road-killed fawns were males and 20 (56%) of 36 fetuses examined during winter and spring 1982 (Dusek 1982) were males.

High rates of recruitment have resulted in increasing proportions of yearlings and 2½-year-olds in pre-hunt populations during the 2 years following 1980 (Figure 2). This tended to suppress the impact of annual production, though not necessarily in an absolute numerical sense.

Table 2. Seasonal herd composition by sex and age of white-tailed deer along the lower Yellowstone in hunting district 750.

Year	Number Classi- fied	Percent Males 2½+	Percent Males 1½	Percent Females 1½+	Percent Fawns	Fawns: 100 Fem. 1½+	Fawns: 100 Ads. 1½+
				Fall (Pre-hunt)			
1977-79[a]	542	10[b]	--	44	46	108	87
1980	540	6	12	39	43	112	76
1981	334	5	11	43	41	96	69
1982	664	8	15	40	37	95	60
				Early Winter			
			---Percent Adults---				
1980-81	687		55		45		81
1981-82	1581		55		45		82
1982-83	1099		56		44		78
				Early Spring			
1981	425		55		45		82
1982	490		59		41		68
1983	563		58		42		73

[a]Pre-hunt data for 1977-79 were from R-7 annual reports and yearly trends were reported previously (Dusek 1982).

[b]Yearling and older males were not separated in the sample of 1977-79.

Fawn Production and Survival

A decline in net fawn production (early fall) was observed from 1980 to 1982. Pre-hunt fawn:doe ratios (Table 2), the ratio of fawns: producing female during summer and early fall and the proportion of adult females successfully rearing fawns to fall (Table 3) all reflected this downward trend. An increase in the proportion of producing females with single fawns at heel was also observed during early fall from 1980 to 1982 (Table 3).

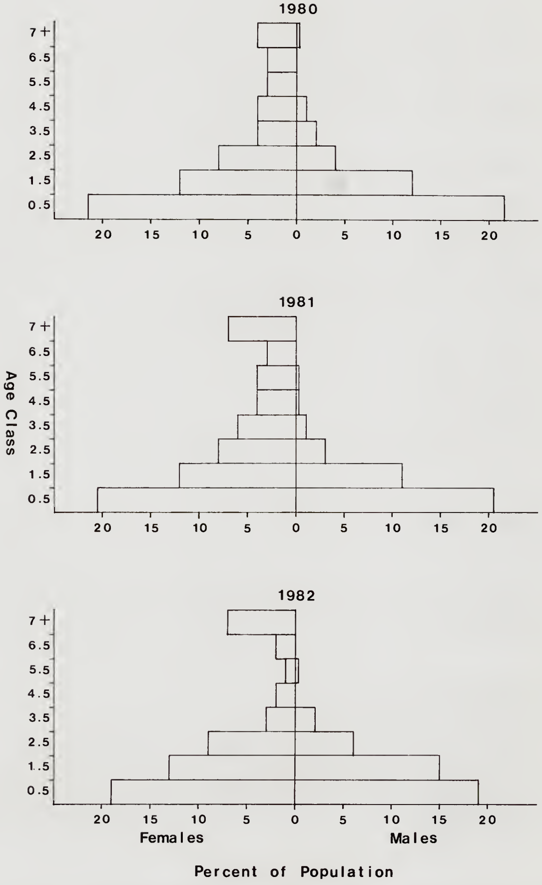

Figure 2. Sex and age structure of fall (pre-hunt) population of white-tailed deer on the lower Yellowstone River, 1980-1982.

Table 3. Productivity of adult white-tailed females on the Yellowstone River during 1980-82.[a]

Period	Fawns:100 Producing Females	Percent Ad. Females Producing	Percent of Producing Females w/ Singles	Twins	Triplets
September-October 1980	154:100 (133)[b]	68	47[c]	51	2
July-August 1981	162:100 (101)	--	41	57	3
September-October 1981	154:100 (123)	60	51	43	6
July-August 1982	154:100 (96)	--	49	48	3
September-October 1982	143:100 (164)	60	58	41	1

[a]Sample obtained from Elk Island, Seven Sisters and Intake study areas.

[b]Producing female sample size in parentheses.

[c]Percent of producing females.

Some mortality of newborn fawns occurred from summer to early fall as indicated by a decline in number of fawns:100 producing females and an increase in the proportion of producing females with singletons at heel during that period of both 1981 and 1982. The reproductive potential for the river bottom population for 1982 was estimated at 187 fawns: 100 producing females as determined from examination of 26 pregnant females during winter and spring 1982 (Dusek 1982). An observed ratio of 143:100 during early fall 1982 (Table 3) suggested that at least 24 percent of the potential had been lost by early fall without considering females from which all fawns carried were lost.

Yearling females were considered non-producers since their contribution to annual production has been negligible. Numerically, they accounted for 30, 28, and 32 percent of the adult female (1½+) segment during 1980, 1981, and 1982, respectively. The difference between these percentages and the proportion of adult females producing during the respective years (Table 3) indicate that 3, 17, and 12 percent of females aged 2½+ did not successfully rear fawns during the respective years. This represented fawn loss in addition to the 24 percent mentioned previously since prenatal data indicated that all females in these cohorts were pregnant (Dusek 1982).

Fawning success was determined for 41 individually marked females during summer and early fall 1982 (Table 4). None of the marked yearling females in the sample successfully reared fawns, whereas 71, 95 and 86 percent of the respective females aged 2½, 3½-5½ and 6½+ years successfully reared fawns. A fawn:adult female ratio, calculated from the differential productivity by age class among marked females (92:100), was comparable to those for the population at large (Table 5).

Table 4. Net productivity of adult female white-tailed deer (1½+) during 1982 as determined from observation of individually marked females during summer and early fall.

Age Class	Number of Females	Percent[a] Prod. Fawns	Percent[b] Multiple Births	Number of Fawns Produced	Fawns: 100 Prod. Females	Fawns: 100 Females
1½	7	0	--	--	--	--
2½	7	71	20	6	120:100	86:100
3½-5½	20	95	74	33	174:100	165:100
6½+	7	86	83	11	183:100	157:100

[a]Includes only those females known to have successfully reared fawns to early fall 1982.

[b]Expressed as a percent of only females successfully producing fawns.

Data from marked females indicated that 2½-year-old females had comparatively less success rearing fawns than older females (Table 4). During 1981, 2½-year-old females accounted for 26 percent of net fawn production which compared to 23 percent in 1982. During the respective years, 2½-year-olds accounted for 28 and 35 percent of the females of fawn producing age classes.

Based on the differential reproductive success by age class among individually marked females, and assuming a pregnancy rate of 12 percent among female fawns of the previous fall from which all neonates dies, total neonatal fawn mortality was estimated at 32 percent in 1982. This compared to 33 percent in 1981 which assumed the same fetal rate as observed in 1982 (187:100). Thus, it appeared that the most successful fawn-producing age classes of females (3½-5½ years), whose combined numbers accounted for 30 percent of all females aged 2½+ during both years, maintained a relatively stable rate of net production.

Table 5. Contribution by age class to net production during 1982 based on differential productivity of individually marked females and on pre-hunt herd composition as determined from aerial surveys and age data of harvested deer.

Age Class	Composition per 100 Adult Females	Number of Fawns Produced	Calculated from Data in Table 3	Observed in[a] Pop. during October 1982
1½	32	0		
2½	24	21		
3½-5½	18	30		
6½+	26	41		
Fawns:100 Ad. Females		92	86	95

[a]Data also appears in Table 2.

Mortality and Survival

Documentation of mortality of individually marked deer showed hunting to be the largest contributor to mortality of white-tailed deer on the lower Yellowstone (Table 6). Hunters killed 22% of the population in the study area during fall 1982 as determined from a change-in-ratio formula (Downing 1980). The proportion of fawns and adults (1½+) killed by hunters (including crippling) was estimated at 9 and 30%, respectively. Twelve of 42 radioed adults (27%) were killed during the 1982 hunting season. From the sample of harvested radioed animals, it was estimated that 14 and 54% of adult females and males, respectively, in the fall population were removed by hunting.

Other types of mortality, such as road-kills, winter-kills, etc., were minor during the past year with no single cause accounting for more than 1% of the population during any given period. Only one radioed deer died during the year from causes other than hunting and was believed to have been hit by an automobile. Automobile/deer encounters were also known to have claimed one neckbanded deer during the year.

Average rates of survival by sex and age class, as determined from estimating population numbers while documenting mortality and also from documentation of mortality among individually marked deer, appear in Table 7. The high average rate of fawn survival was attributed to unusually mild winters in 1980-81 and 1982-83 (Table 1) and hunter selectivity towards adult deer. Although yearlings appeared more

Table 6. Factors contributing to the deaths of 56 of 166 white-tailed deer marked on the lower Yellowstone River during the winters of 1980-82.[a]

	Collared Deer (23)[b]	Radioed Deer (33)	Total (56)
Hunting related[c] deaths	83%	72%	77%
Highway deaths	4%	9%	5%
Other causes[d]	13%	21%	18%

[a]The sample did not include trap related mortality.

[b]Sample size in parentheses.

[c]Hunting mortality includes crippling deaths.

[d]Includes those dying from malnutrition, accidents (other than auto-related) and where the cause of death was not readily determined.

Table 7. Average survival rates of white-tailed deer by sex and age from 1980-83, a period when the population was increasing.[a]

Age Class	Females	Males	Total
½	92%[b]	92%	92%
1½	85% (82%)[c]	71% (59%)	78% (70%)
2½	77% (76%)	46% (29%)	64% (55%)
3½+	82% (78%)	40% (25%)	76% (76%)

[a]Survial is based on the period of fall through spring.

[b]Average survival rates for the biological years 1981-83 as determined from population estimates, herd composition and accounting for mortality occurring in the population.

[c]Survival rates for marked animals in parentheses.

vulnerable to highway mortality than older deer (Dusek 1982). Yearling males were less vulnerable to hunting mortality. This may be related to hunter selectivity for older males. Yearlings averaged 67% of the adult male segment of the pre-hunt population during 1980-82, whereas they accounted for only 44% of the antlered harvest. This trend was observed during all 3 years. The marked difference in survival between age classes of males was not similarly observed among adult females (Table 7).

Population Trend

Data gathered to date suggested that the population of white-tailed deer on the river bottom has steadily increased from approximately 3,000 deer during fall 1980 to over 5,000 in 1982 (approximately 100 deer per mile of river bottom). A model of this growth, using average survival rates by sex and age class, is illustrated in Table 8. The rate of increase, as calculated from the model, was 36% from 1980-81 and 27% from 1981-82. The model assumed a 50/50 sex ratio among fawns during all years.

Three census flights in each of the Elk Island and Intake study units during March and April 1983 resulted in average early spring population estimates of 684 ± 102 and 940 ± 82 deer for the respective units. Approximately 12 and 3% of the respective populations were marked. These estimates represented increases from the previous year of 42% for Elk Island and 123% for the Intake area. The population at Intake may have been overestimated due to the small proportion of marked animals, but the 3 individual estimates, as determined by the Lincoln Index (Davis and Winstead 1980), were consistent. Estimates of deer numbers were not made during other seasons due to reasons cited previously (Dusek 1982).

The white-tailed deer population on the lower Yellowstone most likely has not reached "fill", as defined by Mackie et al. (1980), in spite of declining production ratios of early fall, because fawns were recruited into the adult population in greater numbers each succeeding year since spring 1981 (Table 8). High survival of fawns through the mild winters of 1981 and 1983 may have partially influenced this phenomenon. As a result of increasing numbers of deer on the river bottom, the rate of neonatal fawn mortality from primaparous females has increased possibly due to social competition among adult females during summer. This was substantiated by the following observations: (1) the proportion of fawns in the pre-hunt population has declined over the past 3 years despite a high incidence of pregnancy and high fetal rates among adult females of producing age classes ($1\frac{1}{2}$+); (2) a decline in the proportion of multiple fawns at heel per adult female together with a decline in the proportion of adult females ($2\frac{1}{2}$+) successfully rearing fawns to fall since 1980; and (3) an observed decline in fawn rearing success among individually marked 2-year-old females from 1981 to 1982 (insufficient data was available for 1980). Research on penned white-tailed deer indicated a direct relationship between neonatal mortality of fawns and population density resulting

Table 8. A model of population increase of white-tailed deer on the lower Yellowstone from fall 1980 to spring 1983 using average survival rates and a base population estimate for fall 1980.[a]

	Total Number	Age Class	Males	Females	Percent Fawns	Percent Yearlings	Percent Adults
Early Fall 1980	2,956*	3½+	89	532	43**	24	33
		2½	119	236			
		1½	354	355			
		½	635	636			
		Total	1,197	1.759			
Spring 1981	2,376	3½+	29	426	49	22	29
	2,547*	2½	45	181	45**		
		1½	230	296			
		½	584	585			
		Total	888	1.488			
Early Fall 1981	4,027	3½+	74	607	41**	29	30
	4,317*	2½	230	296			
		1½	584	585			
		½	825	826			
		Total	1,713	2,314			
Spring 1982	3,209	3½+	24	486	47	27	26
	3,465*	2½	86	226	41**		
		1½	380	488			
		½	759	760			
		Total	1,249	1,960			

Table 8. Continued.

	Total Number	Age Class	Males	Females	Percent Fawns	Percent Yearlings	Percent Adults
Early Fall 1982	5,134	3½+	110	712	37.5**	30	32.5
	5,589*	2½	380	488			
		1½	759	760			
		½	962	963			
		Total	2,211	2,923			
Spring 1983	4,019	3½+	36	570	44	28	28
		2½	142	373	42**		
		1½	493	634			
		½	886	885			
		Total	1,556	2,463			

[a]Model does not take into consideration seasonal dispersal of deer from river bottom into adjacent uplands which may account for as much as 10% of the adult segment.

*Actual population estimate taking into account the mortality for that specific year.

**Percent fawns in the population determined by aerial herd composition surveys.

from competition among adult females for fawn rearing space (Ozoga and Verme 1982). It was also determined that fawns of 2- and 3-year-old females suffered measurably higher mortality than those of older matriarchal females as a result of disrupted maternal behavior (Osoga et al. 1982).

Habitat Use

Detailed study analyses of white-tail usage of river bottom habitats are in progress (see Herriges, pp. 84-87) and will not be reported here. In general, white-tailed deer most commonly occurred on portions of the river bottom characterized by a braided stream channel, where the entire spectrum of seral communities of the cottonwood cycle (Boggs 1981) was present in close association with land under intense agricultural use. Adult females confined their movements during daylight hours to small seasonal home ranges of less than 0.1 mi^2, while movements of both sexes of yearlings and adult males were more extensive and less predictable (Dusek 1982).

Adult females exhibited a relatively high affinity for summer home ranges. Eleven females aged 2½+ years during all summers in which they were monitored had an average fidelity index of 0.26. Average fidelity indexes of 0.35 and 3.37 were calculated for 4 females and 2 males which were yearlings during the first summer their movements were monitored.

Population Characteristics of White-tailed Deer on the Richey-Bloomfield Area

The sex and age composition of deer on the Richey-Bloomfield area (Table 9) was similar to that observed on the Yellowstone River bottom. During fall 1982, 90% of the pre-hunt population apparently consisted of animals aged 4½ years and younger. Antlered deer comprised 15% of the pre-hunt population. From samples of harvested and trapped deer, it appeared that few males older than 3½ years occurred in the population, whereas females were well represented in nearly all age classes through 8½ (Tables 10 and 11).

The proportion of fawns in the population increased from fall to early winter (Table 1), probably due to hunter selectivity for adult deer. An observed decline in the proportion of fawns in the population from early winter to early spring suggested some fawn mortality over winter.

A census survey in March 1983 provided a population estimate of 444 deer for the 35 mi^2 study area, a density of 13 deer/mi^2. Twelve (32%) of the 37 marked deer known to be on the study area at the time of the survey were observed during the census flight. The confidence interval (0.95) for the March population estimate was 198-690 deer.

Table 9. Seasonal herd composition by sex and age of white-tailed deer in the Bloomfield-Richey study area during the biological year 1982-83.

Year	Number Classi-fied	Percent Males 2½+	Percent Males 1½	Percent Females 1½+	Percent Fawns	Fawns: 100 Fem. 1½+	Fawns: 100 Ads. 1½+
				Fall (Pre-hunt)			
1982	194	6	10	42	42	99	72
				Early Winter			
				---Percent Adults---			
1982-83	111		52		48	95	91
				Early Spring			
1983	133		57		43	--	75

Table 10. Percent composition by age of 70 white-tailed deer harvested in hunting district 732 during 1982.[a]

Age Class	Females (30)	Males (40)	Total (70)
½	17	22	20
1½	30	40	36
2½	10	27	20
3½	23	7	14
4½	--	--	--
5½	3	--	1
6½	--	2	1
7½	13	--	6
8½	3	--	1

[a]Data from checking stations and jaw collections are combined.

Table 11. Percent composition by age of 49 white-tailed deer trapped in the Richey-Bloomfield study area during January 1983.

Age Class	Females (33)	Males (16)	Total (49)
½	15	75	35
1½	21	12	18
2½	21	6	16
3½	12	6	10
4½	6	--	4
5½	9	--	6
6½	6	--	4
7½	--	--	--
8½	9	--	6

Preliminary data on habitat use by white-tails on the Richey-Bloomfield area have not been analyzed. However, general observations during aerial surveys and relocations of radio-collared animals suggest that these deer are closely associated with deciduous cover along drainages and other microenvironments supporting deciduous trees and shrubs. Individually radio-collared deer each used several different sites with deciduous cover during late winter and spring.

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Submitted by: Gary L. Dusek

STUDY NO. BG-2.0 JOB NO. 3 (Supplement 1)

JOB TITLE: Successional relationships of riparian vegetation along the lower Yellowstone River.

JOB OBJECTIVE: To determine and describe natural plant communities and successional relationships of vegetation along the lower Yellowstone River.

FINDINGS

This study was established during the summer of 1980 in conjunction with studies of the population ecology and habitat relationships of white-tailed deer along the flood plain and islands of the Yellowstone River from Glendive to Sidney, Montana. Field studies were conducted from July through mid-September 1980 and during June-September 1981. The final thesis report has now been completed to be submitted during fall 1983 as a supplement to the 1982-83 Deer Studies Report. A preliminary abstract of that thesis by Keith W. Boggs is presented below:

ABSTRACT:

Deposits on gravel bars and islands create bands of new substrate for plant colonization and community development along the lower Yellowstone River. Surface age, therefore, increases with increasing distance from the river. Simultaneously, annual flooding deposits new material on this surface raising it to equilibrium heights of about 3 m above the river surface in about 30 years.

Communities occupying a surface change from gravel bar to willow-cottonwood seedling, to willow thicket, to young cottonwood forests and to mature cottonwood forests after about 0, 3, 7, 35, and 92 years, respectively. While the mature cottonwood stage is usually replaced, via a rose-snowberry stage, by an *Agropyron* grassland similar to the regional climax, it may be replaced by a green ash forest on low water stress sites.

Changes in the ecosystem with its development are summarized below. Stand height increases from 0 to 25 M at 100 years and falls to near zero again as the cottonwood forests convert to grassland. Numbers of species with constancies of over 60% rise from zero on gravel bars to 18 in the mature cottonwood forest and decline to 13 in the grassland. Composition changes are documented in relevent tables. Cottonwood density falls supra-exponentially from $100/m^2$ at 5 years to $0.01/m^2$ at 100 years; willows disappear more rapidly with declines from $10/m^2$ at 5 years to $0/m^2$ at 25 years. Aboveground biomass rises to 30 kg/m^2

at 60 years and declines to less than 0.5 kg/m^2 in near climax grasslands; most of the large mass observed at mid-sere is living wood. A maximum productivity of 1.15 kg/m^2 yr appears in the 20-40 year period. Belowground biomass rises from about 10 kg/m^2 to over 35 kg/m^2 at 90 years and declines to about 30 kg/m^2 in adjacent grasslands; over half of this biomass is soil organic matter at every stage. Root/shoot ratios decline from 5/1 in the seedling stage to 1/2 in the maturing cottonwood stage and rise again to 10/1 in the grassland. Nutrient contents on the communities and the ecosystem rise and fall with the rise and fall in its biomass.

Several management-relevant observations were made. First, because cottonwood and willow only establish on new deposits, logged cottonwoods will not replace themselves, so logged riparian forests will be replaced by serally advanced shrublands, grasslands or rarely by ash forests. Second, modification of river flows will alter erosion-deposition patterns and resultant community succession. Elimination of overbank flooding will reduce bank elevations and favor species like willow, which require a high water table. Increased in-bank flows would increase the present amounts of early seral stages at the expense of later stages. Reciprocally, reduced in-bank flows, such as would appear with withdrawal of more irrigation or coal slurry water, will favor mature (grassland) systems at the expense of immature willow and cottonwood communities.

STUDY NO. BG-2.0 JOB NO. 3 (Supplement 2)

JOB TITLE: Habitat use and relationships of white-tailed deer on bottomlands along the lower Yellowstone River in eastern Montana.

JOB OBJECTIVES:

1. To determine relative use by white-tailed deer of the various seral stages of natural riparian communities along the Yellowstone River bottomlands;

2. To determine the importance of agricultural lands and crops to white-tailed deer and how land-use practices affect deer distribution and habitat selection;

3. To determine how the distribution of riparian communities and agricultural land affects movements and distribution of deer;

4. To determine daily activity and movement patterns of deer.

INTRODUCTION

This study was initiated during July 1982 as a supplement to an ongoing study of population ecology and habitat relationships of white-tailed deer on bottomlands of the lower Yellowstone River (Dusek 1981, 1982). Dusek's studies of habitat use have emphasized seasonal distributions and movements based on aerial relocations and surveys, during daylight hours. This study is designed as a more intensive attempt to define specific patterns of habitat use throughout all hours of the day.

STUDY AREA

Two of the intensive study units described by Dusek (1981) were selected. The Elk Island unit comprises the Elk Island Wildlife Management Area and surrounding intensively cropped, irrigated agricultural lands. The Intake unit is private land on which livestock grazing and hay cropping are the primary agricultural land-uses.

The natural plant communities along the lower Yellowstone River and their successional relationships have been described by Boggs (1981), who also prepared cover-type maps of the natural riparian vegetation within the intensive study units.

METHODS

Primary emphasis has been placed on monitoring deer movements and habitat use with a ground-based null-peak antenna system at the Elk Island study unit. Deer locations are determined by triangulation. During the period July 19 to September 8, 1982, three 24-hour sessions were conducted, with 14-hour sessions (5:00 p.m.-7:a.m. MST) conducted during each intervening week. Additional telemetry sessions were conducted in October, December, and March. Fourteen radio-collared deer were each located hourly.

Locations were plotted, assigned UTM coordinates, and entered into computer files for analysis with the use of the TELDAY computer program. Printouts of locations of each animal for each session were obtained. Summer home ranges were plotted and sizes calculated by the minimum home range method (Mohr 1974).

In addition, deer have been located with a hand-held antenna and observations of neck-banded and radio-collared deer have been made while carrying out other activities. Land use practices on the Elk Island area have been noted and mapped.

RESULTS

Although detailed analysis of data has not been undertaken as of yet, some preliminary observations and findings can be reported.

Home range sizes were calculated for 14 deer on the Elk Island study unit. The number of relocations for each animal ranged from 32 to 104. Home range sizes and standard diameters (Harrison 1958) by age class and sex are presented in Table 1.

Table 1. Summer 1982 home range sizes and standard diameters of white-tailed deer at Elk Island study unit based on 24-hour and night-time triangulation locations, July 19-September 8.

		Mean Home Range Size		Mean Standard Diameter	
Age Class	Sex	km^2	mi^2	km	mi
Adult[a]	Male (4)[b]	1.96	0.76	1.36	0.84
Adult	Female (9)	0.84	0.32	0.74	0.46
Yearling	Female (1)	1.43	0.55	1.11	0.69
All radioed deer (14)		1.20	0.40	0.94	0.59

[a]2 years and older.

[b]Number of deer in sampe is in parentheses.

Home range plots are generally characterized by a cluster of points surrounded by more widely spaced locations. The clustered points generally represent locations within the riparian vegetation, while the more widely spaced points represent nighttime movements into agricultural fields. Points also sometimes cluster in alfalfa fields and along regularly used pathways.

Adult males generally had large home ranges, travelled more widely, and shifted areas of use more from day to day than adult females. Yearling female 82-23 had a larger home range (0.66 mi^2) than all adult females except for female 82-15.

Deer moved more extensively and ranged more widely during the dark hours than during daylight. This is evidenced by comparing the calculated mean summer home range size based on daylight aerial relocations (0.07 mi^2, Dusek pers. comm.) with those calculated from 14- to 24-hour triangulation sessions (0.46 mi^2, Table 1). Although Dusek's calculations are based on only 9 locations per deer, the difference is due primarily to the recording of movements into agricultural fields by nighttime triangulation.

Most daytime use by radioed deer was concentrated in cover of the mature cottonwood and shrub cover types. During early morning and late afternoon periods, deer were seen in all riparian cover types. Most radioed animals moved into agricultural fields (usually after dusk) during most nights in which they were monitored. Alfalfa fields received heavier and more consistent use than other agricultural fields. Most animals moved back into riparian cover before sunrise. Deer on Elk Island infrequently moved off of the island at night.

Most deer apparently shifted their home range significantly by late October. Movements of five out of ten animals during October 30-31 were entirely outside of their summer home ranges. Animals also made much more extensive movements in October and December than in summer. On December 18 and 19, several animals travelled to agricultural fields during midday. Also, in December the river was ice covered and deer moved freely onto and off of Elk Island.

1983-84 STUDIES

Field studies will be continued during summer 1983 and winter 1983-84, and will be extended to include the Intake study unit. Activities will include:

1. Ground based triangulation work.

2. Spotlighting to determine night-time deer distributions and under what conditions and at what times deer use agricultural fields.

3. Direct observation of radio-collared and neck-banded deer.

4. Monitoring of land-use patterns.

5. Extension of cover-type mapping to unmapped areas.

6. Direct location of animals with hand-held antenna.

7. Counting of pellet groups along transects.

8. Monitoring of weather conditions and their possible effects on habitat selection and activity.

9. Quantification of vegetative differences between the two study units.

10. Analysis of movement and home range data with the TELDAY computer program.

11. Use of the GEOSCAN program to analyze habitat use data, if time and funds permit.

The thesis final report will be prepared during spring and early summer 1984.

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Submitted by: James D. Herriges

STUDY NO. BG-2.0 JOB NO. 5

JOB TITLE: The relationship of white-tailed deer and mule deer to agriculture in the Gallatin Valley.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters for an erupting population of white-tailed deer in the Gallatin Valley, Montana.

2. To relate those basic population parameters to (a) habitat/environmental characteristics of the Gallatin Valley and (b) specific potential limiting factors for deer in that habitat, including nutrition, other wild ungulates, specifically mule deer, agriculture and associated farming practices, domestic livestock and associated grazing practices, rural subdivisions and associated human activities, weather, disease, and hunting.

3. To further develop and test hypotheses relating to deer-habitat interactions and populations regulation; and

4. To develop guidelines for deer management on mountain valley/agricultural habitats.

FINDINGS

This study was conducted as a graduate (MS) thesis research project. Field work was completed in the summer of 1982 and the final thesis report was submitted in June, 1983. An abstract of that thesis, titled "The effects of having developments and agriculture on the ecology of white-tailed deer and mule deer in the Gallatin Valley, Montana" by William O. Vogel, is presented below.

ABSTRACT

Investigations of white-tailed deer and mule deer were conducted from the spring of 1981 through the summer of 1982 on over 100 km^2 in the Gallatin Valley, Montana. The Gallatin Valley is a primarily agricultural high mountain valley with many streams flowing through it. White-tailed deer, quite scarce 10 years ago, currently comprise over half of the deer population. In recent years considerable housing development has occurred. An inverse relationship, existed between housing density and deer observed. This relationship appeared to have a threshold around 4-8 houses per km^2. Deer use was greatest on the moderately arable soils while housing development occurred on the more arable soils. Deer use peaked on land with intermediate densities of houses indicating that development is occurring on deer habitat while marginal deer habitat is

left undeveloped. Deer were less likely to be active during midday if they were near housing developments. White-tailed deer were more secretive, more nocturnal, had greater reproductive capabilities, a shorter life expectancy and appeared greater adapted to human activities than mule deer. Reproductive data collected from carcasses yielded 1.62 fetuses per doe for white tails and 1.23 for mule deer. In conjunction with fawn-doe ratios an estimated fawn mortality of 40% was calculated for the first 90 days in white-tailed deer and 54% for mule deer. The presence of hybrids was also noted.

APPENDIX

A LIST OF PUBLICATIONS RESULTING FROM STATEWIDE DEER RESEARCH STUDIES 1975 - 1983.

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